









**Government of Bengal**

**Forest Department**

# **Nursery and Plantation**

## **Notes for Bengal**

**1935**

**(4th edition)**

*By*

**C. K. Homfray, B.A., I.F.S.**

*Deputy Conservator of Forests, Silviculturist, Bengal*

**Superintendent, Government Printing  
Bengal Government Press, Alipore, Bengal**

**1937**



# TABLE OF CONTENTS.

|   | Pages. |
|---|--------|
| Foreword .. .. .  | 1      |
| General (including choice of species, nursery and plantation work, fencing, etc.) .. .. . | 1-20   |
| <i>Abies densa</i> (Syn. <i>Abies webbiana</i> ) .. .. .                                  | 20-21  |
| <i>Acacia catechuoides</i> (Syn. <i>Acacia catechu</i> ) .. .. .                          | 21-22  |
| <i>Acacia lenticularis</i> (Syn. <i>Acacia ferruginae</i> ) .. .. .                       | 22-23  |
| <i>Acer campbellii</i> .. .. .  | 23-24  |
| <i>Acrocarpus fraxinifolius</i> .. .. .   | 24-26  |
| <i>Adina cordifolia</i> .. .. .   | 26-27  |
| <i>Ailanthus grandis</i> .. .. .  | 28-29  |
| <i>Albizia lebbek</i> .. .. .   | 29-30  |
| <i>Albizia marginata</i> (Syn. <i>Albizia stipulata</i> ) .. .. .                         | 30-31  |
| <i>Albizia procera</i> .. .. .  | 32-33  |
| <i>Alnus nepalensis</i> .. .. .   | 33-35  |
| <i>Alstonia scholaris</i> .. .. .   | 36-37  |
| <i>Amoora wallichii</i> .. .. .   | 37-38  |
| <i>Anisoptera glabra</i> .. .. .  | 38-40  |
| <i>Anthocephalus indicus</i> (Syn. <i>Anthocephalus cadamba</i> ) .. .. .                 | 40-41  |
| <i>Artocarpus chaplasha</i> .. .. .   | 42-44  |
| <i>Artocarpus integrifolia</i> .. .. .  | 44-45  |
| <i>Betula alnoides</i> .. .. .  | 45-47  |
| <i>Betula alnoides</i> Var. <i>acuminata</i> and Var. <i>cylindrostachys</i> .. .. .      | 47-51  |
| <i>Bischofia javanica</i> .. .. .   | 51-52  |
| <i>Bombax malabaricum</i> .. .. .   | 53-54  |
| <i>Bucklandia populnea</i> .. .. .  | 54-56  |
| <i>Calophyllum polyanthum</i> .. .. .   | 57-58  |
| <i>Cedrela febrifuga</i> .. .. .  | 59-60  |
| <i>Cedrela microcarpa</i> .. .. .   | 60-62  |
| <i>Cedrela toona</i> .. .. .  | 62-64  |
| <i>Chukrasia tabularis</i> .. .. .  | 65-66  |
| <i>Cinnamomum cecidodaphne</i> .. .. .  | 67-68  |
| <i>Cinnamomum glanduliferum</i> .. .. .   | 68-69  |
| <i>Cryptomeria japonica</i> .. .. .   | 69-71  |
| <i>Cupressus funebris</i> .. .. .   | 72-23  |

|   | Pages.  |
|---|---------|
| <i>Cupressus tofufosa</i> .. .. .                       | 73-74   |
| <i>Dalbergia latifolia</i> .. .. .                      | 74-76   |
| <i>Dalbergia sissoo</i> .. .. .                         | 76-78   |
| <i>Dichopsis polyantha</i> .. .. .                      | 78-81   |
| <i>Dipterocarpus</i> species (General notes on) .. .. . | 81-84   |
| <i>Dipterocarpus turbinatus</i> .. .. .                 | 84-87   |
| <i>Dipterocarpus alatus</i> .. .. .                     | 87-89   |
| <i>Dipterocarpus costatus</i> .. .. .                   | 89-90   |
| <i>Dipterocarpus pilosus</i> .. .. .                    | 90-92   |
| <i>Dipterocarpus tuberculatus</i> .. .. .               | 92-93   |
| <i>Duabanga sonneratioides</i> .. .. .                  | 94-96   |
| <i>Eriobotrya petiolata</i> .. .. .                     | 96-97   |
| <i>Eucalyptus citriodora</i> .. .. .                    | 97-99   |
| <i>Eucalyptus globulus</i> .. .. .                      | 99-100  |
| <i>Eugenia cymosa</i> .. .. .                           | 100-102 |
| <i>Eugenia grandis</i> .. .. .                          | 102-104 |
| <i>Evodia meliaefolia</i> .. .. .                       | 105-106 |
| <i>Gmelina arborea</i> .. .. .                          | 106-111 |
| <i>Hopea odorata</i> .. .. .                            | 111-113 |
| <i>Hovenia dulcis</i> .. .. .                           | 114     |
| <i>Hymenodictyon excelsum</i> .. .. .                   | 115-116 |
| <i>Juglans regia</i> .. .. .                            | 116-117 |
| <i>Lagerstroemia flos-reginae</i> .. .. .               | 118-120 |
| <i>Lagerstroemia hypoleuca</i> .. .. .                  | 120-122 |
| <i>Litsaea panamonja</i> .. .. .                        | 122-123 |
| <i>Lophopetalum fimbriatum</i> .. .. .                  | 124-126 |
| <i>Macaranga denticulata</i> .. .. .                    | 126-127 |
| <i>Macaranga pustulata</i> .. .. .                      | 127-128 |
| <i>Machilus edulis</i> .. .. .                          | 129-130 |
| <i>Machilus gammieana</i> .. .. .                       | 130-131 |
| <i>Magnolia campbellii</i> .. .. .                      | 132     |
| <i>Meliosma thomsonii</i> .. .. .                       | 132-133 |
| <i>Mesua ferrea</i> .. .. .                             | 133-135 |
| <i>Michelia champaca</i> .. .. .                        | 135-139 |
| <i>Michelia excelsa</i> .. .. .                         | 139-142 |
| <i>Michelia lanuginosa</i> .. .. .                      | 142-143 |

|   | Pages.     |
|---|------------|
| <i>Morus indica</i> .. .. .   | .. 144-145 |
| <i>Morus laevigata</i> .. .. .  | .. 146-147 |
| <i>Phoebe attenuata</i> .. .. .   | .. 147-149 |
| <i>Phoebe hainesiana</i> .. .. .  | .. 149-151 |
| <i>Pinus longifolia</i> .. .. .   | .. 151-152 |
| <i>Podocarpus neriifolia</i> .. .. .  | .. 152-154 |
| <i>Polyalthia simiarum</i> .. .. .  | .. 154-155 |
| <i>Prunus nepaulensis</i> .. .. .   | .. 155-157 |
| <i>Pterocarpus dalbergioides</i> .. .. .  | .. 157-158 |
| <i>Pterocarpus marsupium</i> .. .. .  | .. 159-160 |
| <i>Pterygota alata</i> (Syn. <i>Sterculia alata</i> ) ..  | .. 160-161 |
| <i>Quercus lamellosa</i> , <i>Quercus lineata</i> , <i>Quercus fenestrata</i> , <i>Quercus pachyphylla</i> .. .. .  | .. 162-164 |
| <i>Saccopetalum longiflorum</i> .. .. .   | .. 165-166 |
| <i>Schima wallichii</i> .. .. .   | .. 166-167 |
| <i>Shorea robusta</i> .. .. .   | .. 167-174 |
| <i>Swietenia macrophylla</i> .. .. .  | .. 175-178 |
| <i>Syzygium jambolanum</i> (Syn. <i>Eugenia jambolana</i> ) ..  | .. 178-179 |
| <i>Taraktogenos kurzii</i> .. .. .  | .. 179-181 |
| <i>Tectona grandis</i> .. .. .  | .. 181-187 |
| <i>Tephrosia candida</i> (also a short note on experiments carried out with certain other species, with a view to their suitability as cover crops in <i>sal</i> plantations) .. .. . | .. 187-190 |
| <i>Terminalia crenulata</i> (Syn. <i>Terminalia tomentosa</i> ) ..  | .. 190-192 |
| <i>Terminalia myriocarpa</i> .. .. .  | .. 192-195 |
| <i>Tetrameles nudiflora</i> .. .. .   | .. 195-196 |
| <i>Trowia nudiflora</i> .. .. .   | .. 196-198 |
| <i>Tsuga brunoniana</i> .. .. .   | .. 198-200 |
| <i>Vitex glabrata</i> .. .. .   | .. 200-201 |
| <i>Vitex peduncularis</i> .. .. .   | .. 202-203 |
| Appendix I—Table of seed times .. .. .  | .. 205-206 |
| Appendix II—Diagram of a nursery bed .. .. .  | .. 207     |
| Appendix III—Headings under which Nursery and Plantations Notes for Bengal are to be collected .. .. .  | .. 209-210 |





### **Foreword.**

The fourth revised edition of the "Nursery and Plantation Notes for Bengal" has been compiled in the office of the Provincial Silviculturist during 1935. Thanks are due to all officers, especially to the Divisional Forest Officers of the Province, without whose active co-operation, both in collecting information and help in experiments, revision of these "Notes" would not have been possible.

C. K. HOMFRAY,  
*Deputy Conservator of Forests,  
Silviculturist, Bengal.*

DATED DARJEELING,  
*The 26th October 1935.*



## Nursery and Plantation Notes for Bengal, 1935.

### General.

The third edition is already out of print and many requests for copies are still being received. Since the last edition was issued in 1933 much experience has been gained and many corrections and additions are now necessary. Furthermore, a considerable amount of information has been collected on new species. It has, therefore, been decided that rather than reprint the third edition, it would be preferable to issue a fourth edition instead and so bring our information right up to date.

It has been compiled from the old notes and from records of observations from all grades of Forest Officers throughout the Province.

The need for constant observation and placing on record of such cannot be over-emphasised. Much useful information is lost or not made available through Officers not placing on record such experience as they have gained, and it is requested that any information obtained may be sent to the Silviculturist for record.

Again, inaccuracies may appear, and should be noted for correction in the next issue.

The collection of information takes time and trouble, and it is quite realised that Range Officers have little time to spend on outside work, but it should be remembered that these notes will be a permanent record and should be made available for all Officers in the future.

It has been found that the Form (Appendix III) on which information is to be written up has been of considerable practical value and has lessened office work of both the Range Officers and the Silviculturist.

Information on species that appeared in the previous edition is now considered for the main part to be accurate. Any additional information, or inaccuracies found concerning these species, should be reported to the Silviculturist as soon as possible. It is suggested that the Divisional Forest Officers should issue a Standing Order to their Range Officers that when putting out any of the species that occur for the first time in this edition, or any new species not mentioned, they should submit annually to the Silviculturist, for these species, information as laid down in the Form (Appendix III) until such time as it is considered that all possible information for any one species has been collected and checked.

**Choice of Species.**—It is obvious in the natural forest that certain species are suited to certain localities and a knowledge of habitat is essential for successful regeneration.

Since the last issue of the notes experiments by the Silviculturist and the Divisional Forest Officers have given certain information which ~~have~~ added considerably to our knowledge of the more important species as regards soil requirements, rate of growth, cultural operations, etc., but there is still much to be done, particularly in Southern Bengal, where with the exception of *gurjan* (*Dipterocarpus turbinatus*), *tali* (*Dichopsis polyantha*), *dhakijam* (*Eugenia grandis*), *Chapalish* (*Artocarpus chaplasha*) little is known. Experiments must, therefore, be carried out so as to enable us to successfully regenerate more of our important local species and also to introduce certain valuable exotics which are likely to be suited to the locality.

In Northern Bengal, the success already obtained with the methods in force justify continuation of the former policy until such time as experience has proved a change necessary.

The question of *mixtures* in plantations has now come into prominence owing to the severe damage done by *Urostylis punctigera* to pure *chañp* (*Michelia champaca*) plantations, *Loranthus* to pure *gamar* (*Gmelina arborea*) and *toon* (*Cedrela toona*), and defoliators to pure *panisaj* (*Terminalia myriocarpa*) and *gamar*.

Also it is felt that pure crops of our more intensive light demanders, such as *gamar*, *lampate* (*Duabanga sonneratioides*) *panisaj*, *utis* (*Alnus nepalensis*), etc., will in later years become so widely spaced as to give a very small volume per acre in the final crop and so make the growing of them unprofitable.

It is therefore now our policy to mix our species and to discontinue putting out pure plantations with perhaps the exception of *sal* (*Shorea robusta*) and *teak* (*Tectona grandis*) which are to be found more or less pure in the natural forest. Experiments with different methods of forming permanent mixtures have been carried out on a large scale in all Divisions, and although it is too early to draw any definite conclusions, the following methods appear most suited to our conditions:—

(i) Mixed line sowing of *panisaj* and *chikrase* (*Chukrasia tabularis*), *panisaj* and *toon* (*Cedrela microcarpa* and *toona*), *mandane* (*Acrocarpus fraxinifolius*) and *chikrase*, *gamar* and *toon*, the object being to raise a second storey to cover the ground in plantations where light demanders constitute the principal crop and which will become very open after the first thinning.

(ii) Alternating groups of lines (strips) of several species. The method is simple and requires little supervision at the time of laying out. It is chiefly used when putting out different species of roughly the same rate of growth where alternate line mixtures would for certain result in a pure crop of the faster-growing species. These formations look most promising but it is still too

early to draw final conclusions. Five lines for the faster-growing and seven for the slower would appear to ensure a mixture in the final crop, a lesser number of lines would more than likely result in some species going out near half rotation age. The centre line of each group will contain the trees of the future and tending and thinning will only be done for the benefit of these trees so as to ensure them full room for development.

With this method of mixing as many different species can be put out as desired, but it is not considered advisable to mix more than three or four different species on any one area so as to facilitate the marketing of the final crop.

If for any reason it is desirable to have a mixture in any one group of lines then this can be done; these mixtures with the exception of mixed line sowings are usually of a temporary nature and their uses are explained later on.

(iii) Group planting of several species, individual groups being 36' x 36'. This method requires a good deal of expert supervision at the time of planting, and although mixtures under this method have been put out very successfully, the alternating groups of lines method gives nearly as good a mixture and is far simpler in its layout, and so for this reason is preferable. Approximately the centre tree of each group will be the tree of the future and tending and thinning will be carried out for the benefit of these trees only.

(iv) Alternate line mixtures.—Most suitable for mixing fast-growing light-demanders and slow-growing shade-bearers. In the Chittagong Hill Tracts Division experiments in such mixtures have now been tried for several years and show definite promise. The outstanding successes have been *gamar* with *tali*, and *gamar* with *gurjan* (*Dipterocarpus turbinatus*). The former success is unqualified and the method will presumably be adopted as standard for raising *tali*. It is not yet certain whether alternate lines or groups of lines in the *gamar-gurjan* mixture will be the best, although the former look so promising, a good deal of tending amongst the *gamar* has been necessary to let the *gurjan* (*Dipterocarpus turbinatus*) develop, and further experiments as to the best initial spacing of the *gamar* will be continued.

*Mahogany* (*Swietenia macrophylla*) in alternate lines with *gamar* has not been so successful; although the former looks healthy, growth is very slow at present. It remains to be seen whether, as the canopy rises, the *mahogany* will speed up.

Alternate lines of *panisaj* and *angare* (*Phoebe attenuata*) in the plains of Northern Bengal, and *utis* and *chañp* (*Michelia excelsa*), *utis* and *phusre chañp* (*Michelia lanuginosa*), *utis* and *pipli* (*Bucklandia populnea*), *utis* and *dhuipi* (*Cryptomeria japonica*) in the hills also show distinct promise.

Besides the permanent mixtures mentioned above there are certain temporary mixtures in use where one of the species is put out for a specific purpose, and only remains as long as it does not interfere with the growth of the principal species. Thus *sissoo* (*Dalbergia sissoo*) and *toon*, *pitali* (*Trewia nudiflora*) and *kainjal* (*Bischofia javanica*), *padark* (*Pterocarpus dalbergioides*) and *jarul* (*Lagerstroemia flos-reginæ*) are put out in alternate *thais*. The last-named species in each case is only put out to provide a good ground cover for the other light-canopied species so as to keep down weeds and climbers, and will only be retained as long as it does not interfere with the principal species. Again, *mahogany* and *kainjal* are often mixed in alternate *thais* so as to get a larger area out under *mahogany*, the seed of which is difficult to obtain, the *kainjal* only being retained as long as it does not interfere with the *mahogany*.

Experiments in underplanting as an alternative to even-aged mixtures have been carried out in *gamar* and *teak* plantations by the Silviculturist in Southern Bengal. The results of under-sowing *gamar* with *gurjan* (*Dipterocarpus turbinatus*) and *tali* look extremely promising. With these two exceptions, experiments have yielded little result and tend to show that this method is extremely costly owing to the numerous heavy cleanings, which have to be carried out for the benefit of the undercrop, and so could not be carried out on a large scale. *Chapalish*, *mahogany*, and *mitenga* (*Bambusa tulda*) have also given fair promise as underplants, but results with these species have nowhere near been so successful as with the two species mentioned above.

Generally our policy is on the following lines:—

(i) **Hill Forests in Northern Bengal.**—The species grown in the hills may be divided into two classes—(a) those which produce good timber like oaks, certain species of *Machilus* such as *Machilus gammieana* and *M. edulis*, and *chañp* (*Michelia excelsa*), and (b), those generally of faster growth, which give box-planking and fuel. In the first class, oaks, *katus* (*Castanopsis hystrix*), *Machilus* spp., *chañp* (*Michelia excelsa*) and *pipli*, all indigenous, have been successfully regenerated. In the second class the only indigenous species which up to date has been successful on a large scale is *utis*, but small scale experiments carried out lately show that birch (*Betula alnoides*), *mallata* (*Macaranga pustulata*), *toon* (*Cedrela febrifuga*), *phusre chañp* should also do well. *Cryptomeria japonica*, an exotic, which has proved itself very easy to regenerate has been put out over a large area. The wisdom of this policy is open to question, as at present it is not popular, either as timber, box-planking or fuel, and is difficult to sell even in small quantities; so, when these large areas become mature, it may be difficult to dispose of the produce.

However, recent results obtained with experimental planting of *Cupressus torulosa* and *C. funebris* are extremely promising and it may be possible in time to substitute these for *Cryptomeria japonica*. They have the advantage over *Cryptomeria japonica* in that besides producing good timber they give an excellent fuel.

Several species of *Eucalyptus* have also been tried, of which only *E. globulus* appeared to be doing well, and this also is now dying out for no apparent reason.

Owing to the comparatively small number of valuable indigenous species small scale experiments are still being carried out with valuable exotics which are considered suitable for the locality. In the Silvicultural Nursery and Garden at Takdah, Darjeeling Division, over a hundred species from all parts of the world have been tried and although it is too early to state anything definitely, the following species in their younger stages show distinct promise:—*Pinus thunbergii*, *Alnus incana*, *Juniperus virginiana*, *Chamaecyparis lawsoniana*.

In the foot-hills *sal* is grown where the locality is suitable for it and *toon*, *panisaj*, *chañp* (*Michelia champaca*), *chikrase*, *gokul* (*Ailanthus grandis*), *pakasaj* (*Terminalia crenulata*) are the most favoured amongst other species. *Lampate* was put out in the past, but recently Sample Plots have shown that its growth is sometimes unaccountably checked and many trees between 3' and 4' girth have been found completely dead. Also owing to its spreading habit and extreme demand for light, the volume of the final crop may be so small as to make it unprofitable.

(ii) **Plains Forests in Northern Bengal.**—Where *sal* of fair quality was on the ground before felling, *sal* should be sown, but care must be taken to fill at once all ground unsuitable for *sal* with species which will grow there, not leaving this until the second year when the filling in of blanks is never so successful as good first year planting.

The practice now is to put out valuable miscellaneous species such as *panisaj*, *toon*, *chikrase*, *chañp* (*Michelia champaca*), *malagiri* (*Cinnamomum cecidodaphne*) up to a maximum of 50 per cent. of the *sal*-bearing land,—reason being that *sal* has a limited market, which may, as time goes, be gradually replaced by iron and concrete. Also even if our new plantations are only 50 per cent. stocked, there will be more than twice the volume of *sal* on the area than is at present obtained from the natural forest. Therefore, it was thought wiser to plant up half the *sal*-bearing land with valuable soft woods.

On good soil not sufficiently well-drained for *sal*, *malagiri*, *pakasaj*, *chopalish*, *rakthan* (*Lophopetalum fimbriatum*) *bonsum* (*Phoebe hainesiiana*), *panisaj* and *bali* (*Amoora wallichii*) do well. Depressions are generally filled up with either *jarul* (*Lagerstræmia*



*flos-reginae* or *L. hypoleuca*) or *kainjal*, but experience has shown that it is a waste of time and money to plant up very low areas and small narrow deep depressions occurring in plantations that are likely to fill up with water during the rains, and such areas should be left to come up with coppice, *mallata* (*Macaranga* spp.), etc. On sites with poorer and drier soil *gamar*, *chikrase*, *lampate*, *panisaj*, *malagiri*, *toon*, *latikaram* (*Hymenodictyon excelsum*), *pitahi*, *gokul*, *Albizzia* spp., *setisal* (*Dalbergia latifolia*), *karam* (*Adina cordifolia*), and *sissou* are generally used:

(iii) **Plains Forests in Southern Bengal.**—*Teak* is now confined to the Chittagong Hill Tracts Division, and has been discontinued in the Cox's Bazar and Chittagong Divisions where it had failed. It should be grown only on higher land, as on swampy land along the banks of rivers, the roots seem to rot after about five years and the tree falls under the weight of its own crown.

*Gamar* is very easy to regenerate artificially but difficult to raise. In the Chittagong and Cox's Bazar Divisions deer damage was so bad that no more of this species has been put out. In the Chittagong Hill Tracts, pure *gamar* was put out over large areas, and in spite of the almost annual attack by defoliators its growth in the younger stages was fairly vigorous and promised well for some time. In 1931 it was badly attacked by *Loranthus* which killed out many trees over a large area; and in some cases the attack was so bad that areas had to be re-jhumed and re-stocked with other species. Also from examination of the older Sample Plots it was found that this species being such an intense light-demander had become very widely spaced, and it was felt that the volume of the final crop might be so small as to make the growing of this species unprofitable. For these reasons pure *gamar* will not be put out in future, and experiments are now being carried out to grow it in a mixture with slower-growing indigenous shade-bearers. Up to date alternate line mixtures of *gamar* with *tali* or *gurjan* (*Dipterocarpus turbinatus*) appear to be most successful.

*Mahogany*, an exotic, has done very well on the lower slopes of ridges in the Chittagong Hill Tracts. A sample of its timber was sent to the Forest Economist, who reported very well on it, and efforts are now being made to put out as much of this species as possible in each year's plantation. *Mahogany* appears also to stand shade and should do well in a mixture with light-demanders, but up to date has not done well in alternate lines with *gamar*.

*Padauk*, an exotic, is also being put out and appears to be doing well. It must be mixed in alternate *thalis* with a species

that gives a certain amount of ground cover, such as *jarul*, otherwise being very light-canopied it will be swamped by weeds and climbers.

The practice of putting out *jarul* in wet and swampy areas has now become universal; this species besides being able to stand even temporary submersion, is one of the most valuable species indigenous to Southern Bengal.

In the Chittagong and Cox's Bazar Divisions plantations are still for the most part on a more or less experimental scale. Considerable progress has however been made with the technique necessary for the artificial regeneration of *gurjan* (*Dipterocarpus turbinatus*), *tali*, *dhakijam*, and *chapaish*, and results now indicate that we are justified in putting out considerable areas under these four species.

Experimental work is still being concentrated on indigenous species, the principal of which are *gurjan* (*D. pilosus*, *D. costatus* and *D. alatus*), *telsur* (*Hopea odorata*), *rakthan*, *harina* (*Vitex peduncularis*), *ashval* (*Vitex glabrata*), *khairjam* (*Eugenia cymosa*), *jam* (*Syzygium jambolanum*), *boilam* (*Anisoptera glabra*), *nageswar* (*Mesua ferrea*), *chanp* (*Michelia champaca*), *Eucalyptus citriodora*, *chuangri* (*Dehaasia cuneata*), *panisaj*, *chaubmugra* (*Taraktogenos kurzii*), *pitraj* (*Amoora wallichii*), *hanspatta* (*Podocarpus neruifolia*), *Andaman bawwood* (*Sageræa listeri*), *minjiri* (*Anogeissus acuminata*) and *gutgutia* (*Bursea serrata*), etc.

In the three Chittagong Divisions the *gurjans* have been tried with *bogamedeloa* (*Tephrosia candida*). So far results with *Dipterocarpus turbinatus* and *D. pilosus* appear very promising, the former being most successful and the latter similarly so but to a lesser degree. *Dipterocarpus costatus* and *D. alatus*, on the other hand, are very difficult to raise owing to their extremely poor germination and their habit of seeding sometime before the break of the rains.

*Tali* and *dhakijam* are being raised successfully by dense line sowings in conjunction with *boga-medeloa*. *Tali* is also doing extremely well when put out in alternate lines with *gamar* and this latter method will most probably be adopted as standard for raising *tali*.

*Telsur* on the lower slopes of ridges appears promising especially when put out as stump plants.

*Chapaish* is impossible to raise on areas frequented by elephants and should be confined to localities where no elephants are found, as in the Ramgarh-Sitakund and South Sitakund Ranges in the Chittagong Division and round about Tinconia in the Chittagong Hill Tracts. It has done extremely well when

raised by dense line sowings in conjunction with *boga-medeloa*, and is also a useful species for underplanting and growing in a mixture with light-demanders.

*Rakthan* with *boga-medeloa* has done very well both as one-year old transplants and two-year old stump plants.

*Ashwal*, *harina*, *boilam*, *panisaj*, *chaulmugra*, *nageswar*, *chuangri*, *khairjam*, *banspatta*, *pitraj*, *minjiri*, *gutgutia*, and certain *jams* are now being experimented with but no definite conclusions can yet be arrived at.

*Toon* is difficult to raise as it is badly attacked by deer. Direct sowing is a failure, as the seeds get washed down the slopes, and so transplants must be put out.

*Kainjal*, another indigenous species, is of no great value in the Chittagong district, and is not put out on any large scale, but is useful for filling up wet ground when sufficient *jarul* seeds are not available.

#### Nurseries.

Good nurseries and nursery work are essential, both when the nurseries are large to provide for extensive planting, and when they are small to provide only a small number of plants for filling blanks. It is easier to get good work done in a large central nursery than in a number of small scattered ones, but where the areas to be planted are scattered, the cost of carrying plants from a central nursery may be so high that small nurseries are necessary.

**Nursery Site.**—The nursery should of course be situated as close as possible to the area to be planted. In the hills they should be made on the easiest slope available to avoid heavy expenditure in terracing. Below 4,000' a northerly aspect is desirable, above this altitude a westerly or south-westerly aspect is best as the rainfall in Bengal is heavy and northerly aspects above 4,000' are very moist and cold. A water-supply is advisable, though not absolutely necessary with all species. Heavy clay-soils are not suitable for nurseries, but any light soil will do as the plants are grown in soil prepared with leaf mould. For the same reason, a nursery never becomes exhausted and a good site is only abandoned when the planting area has moved too far away. The area must be fenced.

**Laying out.**—Beds should run from east to west in the plains; in the hills or on hilly ground they must of course follow the contour. They should be made in continuous lines, six feet wide with a few narrow cross paths intersecting them, and between the beds, a gangway three feet wide should be left. It is a mistake to crowd the beds closer than this as side light and free circulation of air are most necessary. In the hills the land must be

terraced 10' wide, 6' for the actual bed and 2' on either side for pathways. In large nurseries it is convenient to lead water in bamboo pipes to a series of sunken barrels down the middle of the area.

**Area.**—Twelve running feet of bed, 6' wide, locally known as a *kamra*, is taken as the unit for nursery work (see Appendix II). For 6' x 6' planting it may be taken that two such *kamras* pricked out will be required for each acre of planting area. These *kamras* should not exceed 24' in length. This allows for both seed and pricking-out beds as well as some margin for contingencies and rejections. On this assumption one acre of a nursery will serve for about 200 acres of planting (unless the plants have to be kept for more than a year in the beds as is the case with some species above 5,000').

**Preparation of seed-beds.**—The beds must be hoed one foot deep, all roots removed and the surface levelled. Leaf mould should be collected early in the cold weather and spread out to sweeten, and then stored under shelter after sifting. Beds should be made up before the rains break, the best time being before February, if possible. They are raised at least 6 inches by a layer of leaf mould mixed with the local soil, screened and spread over the hoed-up surface of the land. An admixture of charcoal dust and ashes tends to correct acidity and to keep away worms. In unshaded beds the use of sand as a soil cover which should be coarse, gritty and free from silty matter will prevent caking of the soil during heavy rain and speed up germination. By varying the proportion of leaf mould to soil it is possible to force or retard growth, an important point with some species. Poles or planks are fixed round the edges of the beds to prevent the mould from falling and the surface of the bed should be quite flat, not convex. Rats often do a considerable amount of damage in seed beds especially in the hills. They can be kept off the bed by fencing the edges with bamboo mats 2' above and 6' below the ground, both sides of the mats being painted with coal tar.

**Shading.**—In the plains and at low elevations in the hills, cover from the drying sun of the hot weather and the heavy downpours of the monsoon is essential for raising species with small seeds. At high elevations shelter from rain is necessary during the monsoon and from frost and snow during the winter. Hail may damage seedlings in unshaded beds anywhere. Shades should slope from six feet on one side of the bed to three feet on the other, the higher side being to the north in the plains and usually away from the hill-side in the hills, though in certain circumstances it may be better to face them inwards. They are made of thatch grass in the plains wherever this is available, and usually with bamboo mats in the hills. The former material is

cheaper and better than the latter, which, however, possesses the advantage of being easily removed and replaced. In the Darjeeling Division, where bark of *Cryptomeria* is available from trees removed in fellings, the practice has been to use strips of bark overlapping each other in place of bamboo mats. It is reported that the cost of such shades per *kamra* is Re. 1-6 and lasts for five years, whereas bamboo matting works out at Rs. 3-4 per *kamra* and seldom lasts for more than one year. To the posts supporting the shades horizontal poles are lashed a few inches above the level of the bed to support a plank, from which weeding and other operations are carried out. Beds narrow enough to allow of reaching across have been tried, but are not found to be economical.

Shades should be removed after the completion of hailstorms from beds to be pricked out in the rains of the same year. In all cases shades should be removed from pricking out beds some time before the plants are to be taken up, so that the shock of being transplanted, and exposure to full sunlight for the first time do not come simultaneously. This hardening process can be made still more gradual by removing the mats one at a time where two thicknesses are used. In unshaded beds particularly, thatch grass is sometimes spread on the surface to keep the soil moist, and is removed after germination. One objection to this practice is that a lot of damage may be done to seedlings at the time the grass is taken off. Another objection to grass covering is that white ants, rats and insects are harboured in the grass and damage seedlings.

**Collection of seed and storage.**—A tabular statement showing seed times of different species is given in Appendix I. Seed should be collected as soon as it is ripe, but great care must be taken not to collect unripe seed. Many instances of failure to germinate are due to using unripe seed. It is advisable to collect seed from vigorous well grown trees with large crowns and straight stems rather than from poor specimens, and to use large seed in preference to undersized. If seed is scarce it may also be collected from quite young saplings, provided the size of the fruit and seed is quite normal. Where seeds are collected from the ground such as *sāl*, *gurjan*, etc., great care should be taken to collect only freshly fallen seeds, and before collection all undergrowth below the mother trees should be removed and the ground carefully brushed, to make certain of removing any previously fallen seeds, which may be rotten or insect-attacked. Seed collection should then be done daily so as to ensure the collection of freshly fallen seeds. The special points to be attended to in treating seeds are given under each species. Where much seed is to be stored special sheds should be built fitted with bamboo shelves, 3' wide, with movable trays to facilitate drying. The

trays may be divided into compartments so that different species will not get mixed, and the shelves covered with wire netting to prevent damage by rats, etc. The design of the shed should be such that there will be no danger from excessive damp or from overheating. Seeds must be thoroughly cleaned and dried before storing and when stored should be turned from time to time. If time is available germination tests should be made after collection and again some time before sowing. Small seeds may be tested between moist sheets of blotting paper and larger ones in saw-dust which must be kept damp. All heavy seeds such as *Quercus*, *Machilus*, *Juglans*, etc., are best stored by burying them. Both the seeds and the soil in which they are to be buried must be quite dry. Neglect of this point may result in heavy loss. Before storing these heavy seeds a water test is made; seeds which float are bad and are rejected and only the sound seeds which sink are stored. A similar test is made before sowing and unsound seed again rejected.

**Sowing.**—There is no economy in being sparing with seed beds. They represent a very small part of the cost of nursery work and are always used for pricking out beds in the end; therefore sow the seed beds thinly unless there is reason to expect bad germination (as in the case of *Terminalia myriocarpa*).

Small seeds are sown broadcast or in drills 3" to 4" apart, the latter way saves labour in weeding. Very small seeds such as *Duabanga sonneratioides* cannot be sown satisfactorily in drills and such seeds may be mixed with either ashes, sand or soil before sowing and a little fine soil scattered over the bed. Large seeds are dibbled in at even depth and spacing, the general rule being that the upper surface of the seed should be at a depth equal to the diameter of the seed. Beds should be well watered before sowing and again immediately after, to settle the soil and the seed. A fine rose watering can should be used. From the time of sowing till germination careful watering is necessary. Some species, e.g., *Bischofia*, *Duabanga*, *Terminalia myriocarpa*, are planted out direct from the seed bed, but the majority are pricked out 4" x 4" into another bed as soon as they can be handled, that is to say, when they are about three inches long, including the roots. In the case of species that have to be transplanted with balls of earth, seedlings should be spaced in the pricking out beds even up to 6" x 6", otherwise it is difficult to raise proper balls of earth.

Seeds treated with red lead are less likely to be attacked by pests.

**Pricking out.**—This term has become universal though the process described below is generally employed as being less likely to lead to the doubling up of the roots than simply dibbling the plants into the beds. The importance of *pricking out* is often

lost sight of, and it is quite common to find sowing done thinly in the nursery bed with the sole purpose of avoiding this operation. Although it may not be necessary in the case of species such as *kainjal* that are planted out a short time after germination, yet it cannot be too greatly emphasised that *pricking out* is essential for species that are kept for any length of time in order to obtain a healthy and bushy root-system instead of a long tap root. More transplants die off owing to a damaged root system than is fully realised. It is a common mistake to prick out seedlings too small especially in case of *conifers*. About 3" to 4" above ground is the most suitable size, seedlings smaller than this cannot always stand the shock with the result that a large percentage never develop into healthy transplants. This has been very noticeable with *hemlock* (*Tsuga brunoniana*).

*Pricking out* is done with a planting board, a piece of plank-ing six feet long and three inches wide with a notch cut every three inches along one of its edges. The planting board is laid across the width of the bed and a trench somewhat deeper than the roots of the seedlings made along the notched edge. A seedling is placed at each notch and the trench is filled in to hold them upright; after *pricking out* water with a fine rose. In some Divisions *pricking out* is done direct by hand, but the above method is less likely to damage seedlings by doubling up roots. Allowance should be made both in the seed and *pricking out* beds for the rejection of plants of poor or misshapen growth. The *pricking out* beds require less care and attention than seed-beds, and if the nursery is far from the planting area it may save cost in transport to make the *pricking out* beds in the planting area, provided that water is available there, if required.

**Weeding and watering.**—It is very necessary to keep the beds thoroughly weeded. Weeding of seed-beds is done as soon as germination is complete and as often as required thereafter. It is best done by women, who at the same time loosen the soil round the plants with a pointed stick—a very beneficial operation which causes the plants to make a decided spurt.

Weeding of *pricking out* beds is necessary at intervals of about a fortnight, possibly longer in the hills. As in the seed-beds, loosening of the soil is done at the same time as weeding.

Watering is generally necessary in the dry season, but care must be taken not to overdo this as too wet beds cause *damping off* of seedlings and a growth of moss, and it is certain that more plants are killed by over-watering than by drought. This is particularly noticeable in the hills, where it is more often the exception than the rule to find a bed that is not over-watered, especially during the rains, when watering should seldom, if ever, be required. A good indication of over-watering is yellowing of

the leaves coupled with a growth of moss. A remedy for *damping off* is to sprinkle seed-beds after sowing with a thin layer of sand. Watering should be done in the afternoon in the plains, and in the forenoon in the hills where there is danger from frost. A watering can with a very fine rose (preferably Haw's patent) is best. Each nursery should be in charge of a *mali* doing whole-time work.

**Temporary Nurseries.**—It is often that a small temporary nursery in the coupe will give all the plants required, and may prove cheaper and more effective. In the plains, water for a temporary nursery can often be got more cheaply by digging a shallow well than by carrying from a stream, and the well will also supply the wants of the coolies working in the planting area.

With *teak* in Southern Bengal, it has been found more satisfactory for each *jhumia* to have a small temporary nursery within his *jhum* for in-filling his area.

In the plains of Northern Bengal, very few species are now put out as transplants, except such as *chañp* (*Michelia champaca*), *rakthan*, *bonsum* and *kainjal*; and, for this reason it would be expensive to maintain permanent nurseries for so few species. Temporary nurseries for these are, therefore, usually laid out adjoining the current year's coupe.

At Sukna, in the Kurseong Division, an inexpensive type of temporary nursery for *chañp* (*Michelia champaca*) has been introduced. The method is as follows:—All undergrowth between the *sal* lines in a small area of plantation adjoining the current year's coupe is cut, burnt, and then given a deep hoe—the space between the *sal* lines being used as sowing and *pricking out* beds. Shades are then erected by putting in *kuchha* posts and covering the top with brushwood. Sowing is done after smoothing the soil and later the young plants are *pricked out*. No raised beds are prepared, and it is reported that ball-planting is much easier from non-prepared beds, as the earth clings to the roots better and it is easier to get up a clean ball than in the case from a raised and prepared nursery bed, where the soil is more friable. The cost of this nursery is about 12 annas per *kamra*, as against Rs. 2-8 for a prepared nursery.

In the hills where most species are put out as transplants, permanent nurseries are still the practice. But with such species as *Cryptomeria*, which is often kept up to three years in the nursery, it is advisable to put up a temporary nursery at least two years ahead of the actual clear-felling in that area. This will save the cost of carrying such large plants over long distances.

Kurseong Division reports that *chañp* (*Michelia excelsa*) does much better in an entirely new nursery site, therefore temporary nurseries for this species are usually made in the coupe due for clear-felling in the following year.



**Planting and direct sowing.**—The commonest spacing for planting is  $6' \times 6'$  and planting is done in prepared planting holes, locally known as *thalis*. Regular spacing and correct alignment make subsequent tending easier, so the area is first staked. Bamboo slips, when available are better than stakes, being less liable to attract insects. They should be hammered in deep. The *thalis* are prepared at the end of the cold weather by digging holes about  $1' \times 1'$  and  $1'$  deep and leaving them open for about a month. Then the hole is filled with soil, free from roots, stones and weeds, partly taken from the hole itself together with a mixture of surface soil from near by. The filled-in soil should stand a few inches above ground level, so that a depression is not formed when the loose soil settles down after rains. Staking every plant is expensive and it is possible that *skeleton staking* will prove sufficient on favourable ground. For example, staking every fourth plant in the lines might be tried.  $6' \times 4'$  staking is sometimes done in the hills. *Jarul* in the plains and *oaks* in the hills are always put out  $4' \times 4'$ . In order to get clean boles and evenly grown timber *conifers* should never be put out more than  $4' \times 4'$ .

**Time of planting.**—For localities above 5,000' the best time for planting is mid-May to mid-June, at lower elevations and in the plains from mid-June to mid-July. Once conditions have become suitable, the earlier the planting is done the better, as the transplants get a longer growing season in the first rains and are better able to withstand the drought of the following hot weather. Every effort should therefore be made to get planting completed as early as possible.

In the hills winter transplanting can be done with the majority of species. Experiments show that winter transplanting in the plains of Northern Bengal is successful with nearly all species. It should be done on the first sign of winter rains and provided it is done carefully and immediately on raising from the beds cent. per cent. success should be obtained. It does not appear necessary to strip the leaves although some Range Officers prefer to do so. It has been suggested that where labour is scarce during the rains, with consequent difficulty in getting the area planted up, a portion of the area may be sown up with *bogamedeloa* or some other cover crops in lines  $6'$  apart and that during the cold weather winter planting can then be done. *Bogamedeloa* besides keeping the area clean during the rains will act as a shade crop to the young plants during the first cold and hot weather and afterwards may be cut out or thinned as considered necessary.

**Planting.**—Generally the best size of seedling for planting is  $4'$  to  $8'$  in height above ground, but with some species, e.g., *Cryptomeria*, larger transplants have been found to be preferable. Larger plants want more careful handling and larger *thalis* and

cost more to transport. The shock of transplanting is lessened if a handful of soil from the nursery is taken with each plant. To facilitate this, beds are watered more heavily than usual for 2 or 3 days before lifting the seedlings.

Great care should be taken to see that plants are planted immediately after raising from the nursery beds. Villagers are very liable to keep surplus plants after a day's planting in their houses until the next day. This habit must be stopped. The best way of supervising planting is to plant from one end to the other and not let individual villagers plant up their own areas separately.

Plants which are kept in ~~the nursery~~ till the second rains (e.g., *Cryptomeria*) should be uncovered and fully exposed during the dry seasons preceding planting.

In some Divisions, with certain species, e.g., *chañp* (*Michelia excelsa*), *lali* (*Amoora waltichii*), etc., the practice is to transplant natural seedlings from the forest direct into the plantation. In the case of *chañp* (*Michelia excelsa*), however, some Range Officers do not report very favourably and state that such transplants have a very branchy habit of growth, but this has yet to be verified. In some Ranges, these natural seedlings are put out in the *pricking out* bed for a year before planting, so as to prevent loss due to sudden exposure.

The following points must receive careful attention at the time of planting:—

- (1) The roots must be placed normally and not doubled up.
- (2) The plant should be at the same depth in the soil as it was in the nursery.
- (3) The soil round the plant should be thoroughly pressed down to bring it in close contact with the roots.
- (4) The centre of the *thali* should be slightly above ground level to prevent the formation of a basin. If it is left too high, soil will be washed away and a part of the root exposed.
- (5) The planting hole should be slightly deeper than the length of the roots.

Light wooden boxes 2' x 18" x 4" are useful for carrying plants with balls of earth; they can be slung on the ordinary carrier. At the planting site, for each pair of planters a woman or boy carries seedlings from the boxes to the planting holes, taking care that the balls of earth are kept intact. Plants must be handled by the ball of earth and not by the stem.

Planting in baskets or bamboo *chungas* can be done at any time of the year.

Baskets of size 4" to 5" diameter and 8" depth are made of strips of bamboo. Care must be taken to see that the baskets are made deep enough otherwise roots will not develop properly, and plants will die back. *Chungas* are sections of bamboo about 8" long and without nodes. It is advisable to split the bamboo and then tie it together with something that will soon decay. This method of planting is expensive and only used when plants are delicate or difficult to raise in sufficient quantities, e.g., *Eucalyptus* spp.

**Planting of root and shoot pruned seedlings.**—Root and shoot cuttings, otherwise known as stumps, should be obtained from healthy seedlings usually from one to two years' old and about as thick as the forefinger. The tap root should be pruned down, with one clean slanting cut, to not less than 9" in length, and the shoot should be pruned back to the collar or not more than one inch above it. Side roots should also be cut clean where they join the main root. Stump planting is usually done at the break of the rains but with certain species, like *teak* and *jarul*, pre-monsoon stumping after the first showers in April gives far better results both in rate of growth and survival per cent. Experiments with pre-monsoon stumping of other important species should also be carried out.

**Sowing at stake or in lines.**—When seed is plentiful and easy to collect, e.g., *sal*, *gürjan*, *toon*, *panisaj*, *gamar*, *gokul*, *pakasaj*, *chikrase*, etc., continuous line sowing is far preferable to sowing at stake and is now the recognised practice. It gives many more seedlings and cleanings and weedings are facilitated, also growth from line sowing appears more rapid. The procedure is described in detail in the notes on *Shorea robusta*, *Cedrela toona* and *Terminalia myriocarpa*.

For sowing at stake, *thalis* are prepared in the same way as for planting, and a few seeds sown in each *thali*. The seed should be sown well apart so that excess seedlings can be transplanted into blanks without disturbing the one left. Stakes should be well driven in or they may fall and a *thali* be lost sight of.

In line sowings with small seeds, such as *toon*, *chikrase*, *panisaj*, etc., the seeds often get washed into heaps and germinate in clumps. Seedlings from these clumps should be pricked out as soon as they are big enough to handle and used to even up the spacing in the line. Direct sowing of small seeds should not however be done on undulating ground, otherwise the seeds are liable to be washed away and seedlings have to be collected from some distance and pricked back into the lines again. Experience has shown that when putting out such areas it is cheaper to make *kuchha* unshaded nurseries maintained by the villagers and to prick out seedlings about 2' apart in the lines. Again experience indicates that it is

not advisable to sow direct certain species such as *panisaj* and *toon* when *bhadai paddy* constitutes the field crop. This *paddy* grows very tall and dense and unless the villagers are forced to grow it some distance from the lines the seedlings are completely smothered and die off. It has been found, however, that if seedlings are pricked out from nurseries into the lines they do quite well and the *paddy* does not appear to affect their growth to any great extent.

Reserves of seedlings to fill blanks may be secured by sowing seed on patches of good ground at various parts of the area under sowing.

**Filling blanks in plantations.**—Blanks should be filled up either in the first cold weather or in the second rains. Winter planting will be done with entire transplants, but when in-filling in the second rains it is preferable to use root and shoot cuttings whenever possible. In-filling after the second rains is usually a waste of time and money owing to the heavy expenditure involved in cleanings in order to raise the young plants, and experience has shown that if a plantation is not fully stocked by the end of the second rains it should be left as it is.

• **Tending.**—Success or failure depends to a very great extent on the conditions of growth during the first year, especially during the first 4 or 5 months of growth. Plantation work in the initial stage is, therefore, very similar to ordinary agriculture. The amount of tending necessary depends on the rate of growth of the species and on whether the intervening spaces are occupied by well-cleaned field crops or by jungle. Very little tending of the crops is necessary with fast growing species when two years' cultivation of the field crop is done; cleaning will usually be necessary after the removal of each crop and soil round the roots should be loosened at frequent intervals. For *sal* grown with field crops some forking and weeding will be necessary, and climber-pulling will have to be done from the third year. The usual arrangement when the crops belong to the villagers is that they do all necessary cleaning up to the end of the second rains without payment. If the area is not under field crops, jungle must be kept sickled back well away from the plants, three or more weedings will be necessary during the first rains, one or more in the second and one in the third. In the case of *sal* even more weeding will be necessary.

*Bogamedeloa* (*Tephrosia candida*), as a cover crop to keep down weeds and climbers, is now universally used in *sal* plantations. It is also used in raising species such as *gurjan*, *rakthan*, *tali*, etc., that require a certain amount of shade during the first few years, and besides acting as a shade crop, it helps to keep down weeds and climbers, and is specially useful in Southern

Bengal in keeping down the pest *assamlota* (*Eupatorium odoratum*). *Arhar* (*Cajanus indicus*) was tried but found to be unsuitable. A note on several other species which have been tried or are being tried experimentally as cover crops will be found under *Tephrosia candida*.

Weeding and cleaning is best done at the beginning and the end of rains. It is a good plan when making the final cleaning to spread 3 or 4 inches of cut jungle over the forked-up *thali* as a mulch and to cover this with a thin layer of earth. Only such jungle as will decay quickly should be used. *Ilami* (*Ageratum conyzoides*) forms an excellent mulch and is generally plentiful. Mulching is particularly advisable on dry ridges into which the roots have not penetrated to any great depth so that the plants are likely to die off through lack of moisture in the dry weather.

In the three Chittagong Divisions seedlings are very liable to be killed off by drought during their first few hot weathers, especially on the more exposed south and west aspects and on the tops of ridges. The soil should, therefore, not be exposed unduly and heavy cleanings, especially during the cold and hot weather, should not be done. Only weeds actually interfering with the growth of the plants should be cut, the remainder being left to shade the soil. Climber pulling, however, should be done when necessary.

Climbers appear to get a hold in plantations in their third or fourth year, i.e., the year after the *taungya* crop has been removed. Climber-cutting in the past has done little to eradicate them. By cutting the climber just above the ground it is found that from each cut two or more shoots are produced. This multiplies year by year as the climbers are cut over. Climber-pulling is now the practice, and is described under *Shorea robusta*.

In the past it was the practice, when cleaning and climber-cutting in plantations of three years and over, to cut back all the undergrowth. It has now been realized that this is a mistake, and all undergrowth, not actually interfering with the plants, should be allowed to come up, thus forming an understorey, which may help to keep down climbers.

Thinning in plantations has been made the subject of a separate note, as if included in these notes would make it too bulky.

**Fencing.**—Where pigs and deer are present in any number, plantations must usually be fenced for not less than 5 or 6 years. Pigs uproot young *sal*, and deer browse and gnaw the bark of the majority of the principal miscellaneous species. Fencing, which is the most expensive item in the life of a plantation, to be

really effective must be continuous, unbroken and put up with great care and maintained in good repair. Experience has shown that "Frost Ring lock" wove wire,  $9\frac{1}{4}$  gauge, 48" high, is the most suitable.

Dry posts of hard and durable wood, such as *sal*, *khair* (*Acacia catechuoides*), *pakasaj* and *jakrikat* (*Phoebe lanceolata*), 12' in length and from 2' to  $2\frac{1}{2}$ ' in girth, should be barked, dressed and fixed 3' in the ground, and from 15' to 20' apart. The portion to be underground should be charred before fixing. If such posts are not available, *live* posts of *mainakat* (*Tetrameles nudiflora*), *taniki* (*Bauhinia purpurea*), and *phallida* (*Erythrina stricta*, or *indica*) may be used. The fencing should be buried 4" below the ground to keep out pigs, and stretched as tight as possible with a wire strainer. Above the wove wire, two strands of two-ply barbed wire are to be fixed tight, the first 1'—6" above the wove wire, and the second 2' above the first, in order to keep out deer. All wire must be fixed tightly to the posts with staples. When the fencing passes over a stream or depression, the space between the bottom of the wire and the bed of the stream or depression should be filled up by making a fence of sticks and brushwood. Stiles must be put up over the fencing at all points where it strikes any inspection path. Great care must be taken and continual inspection is necessary to ensure that fencing, once put up, is kept in good state of repair. Plantations showing great promise at the start have often been ruined by lack of attention to this matter, thus allowing entrance to game.

**Inspection paths.**—In the plains these must be maintained round the boundary of each annual plantation, and in addition a passable track kept open diagonally (or approximately so) through them. Wherever these paths or tracks cut a line of fencing a stile must be put up. At each stile, at the four corners of each annual plantation and where a path cuts its boundary, boards must be put up. Each board will bear *one number only*, the year of the plantation, and this will face the observer when he faces the plantation to which it refers; arrows and other cryptic signs are forbidden.

In the hills, paths should be made with an easy gradient to facilitate inspection.

**General.**—As a general rule the quicker the saplings can be established, the cheaper and more satisfactory will the work be, and labour is more economically employed in forcing plants on in their early stages than in keeping them alive after they have had a set-back. The aim and object of all plantation officers must be the attainment of full stocking during the first year, as a patchy plantation will require more cleaning in the second

year, and in-filling is seldom a complete success. If a plantation is not fully stocked by the end of the second year, further in-filling will generally be useless unless labour is available to do frequent cleanings in the third year, and even then it is doubtful if it will justify the cost. In experimenting with untried species it may be taken as a rule that the seed and not the whole fruit should be sown, and if the seed does not ripen at such a time as to allow of plants 4" to 8" high being produced by the beginning of August (in the plains) or in the middle of July (in the hills) experiments in storing the seed should be made. With most species thoroughly dried seed can be stored for a considerable time if not exposed to extremes of temperature or to damp.

The commonest mistakes in nursery work are:—

Collection of unripe seed, bad organisation (e.g., insufficient pricking out beds for the number of seed-beds), beds too narrow, shades too low, over-watering and under-watering.

The commonest mistakes in planting are:—

Use of too big plants, doubling up of the roots, planting too late, not planting immediately after raising plants from the nursery beds, leaving the top of the *thali* as a depression, making the *thalis* too small, and not pressing the soil down firmly enough round the plant. It is perhaps unnecessary to emphasise the importance of having an ample supply of transplants in the nursery ready for the planting season.

***Abies densa*** (Syn. *Abies webbiana*) (*Silver fir*—Eng., *Gobresalla*—Nep.).

1. *Locality*.—Hill forests from 10,000' to 12,000' elevation.
2. *Seed time*.—Seed ripens in October-November.
3. *Weight of seed*.—10 lbs. of cones produce 1 lb. of clean seed. 470 seeds to the ounce.
4. *Method of collection of seed*.—Cones should be collected from the trees when they start to open.
5. *Method of treating seed*.—Cones are laid out on mats in the sun which open out and liberate the seed, the scales falling off at the same time. The seeds are then sifted to get rid of the scales.
6. *Method of seed storage*.—Seeds can be stored in gunny bags but must be put out in the sun from time to time to prevent mildew.
7. *Sowing (method and quantity of seed)*.—Seeds are sown broadcast in nursery beds in February under shade,  $1\frac{1}{2}$  lbs. to the *kamra*.

8. *Germination (time, percentage, etc.).*—Germination good and is complete in about 6 weeks.
9. *Treatment in nursery.*—Prick out 6 weeks after germination in well-raised beds under shade and water daily. Shaded beds are not necessary except to prevent damage by heavy rain and hail. Growth is very slow and the seedling reaches a height of 8" only in 3 years. For this reason plants should be kept in the nursery for at least three years.
10. *Method of transplanting.*—Seedlings are planted entire without any earth round the roots 6'  $\times$  6' in *thalis* in June. Planting should be completed at the latest by the middle of July. Planting when done after July has not been successful.
11. *Treatment after transplanting (weeding and cleaning).*—Establishment takes about 5 years and up to this period at least three cleanings a year are required. Once established, heavy cleanings are not necessary.
12. *Tending.*—
13. *Diseases and pests.*—Suffers badly from fire.
14. *Rate of growth.*—Slow. At Rimbick, Darjeeling Division, at an elevation of 7,500', the average rate of growth in plantation is as follows:—1st year—4"; 2nd year—6"; 3rd year—9"; 4th year—2'—8"; 5th year—7'—10"; Sample Plot No. 21 of Darjeeling Division at Sandakphu at an elevation of 11,150' gave an average diameter of 13.3", height of 85', and volume of 6,432 c. ft. of timber per acre down to 8" diameter, in 102 years. Sample Plot No. 15 of Darjeeling Division at Senchal at an elevation of 8,000' gave an average diameter of 7.3", height of 37', in 31 years.
15. *General remarks.*—The species does not appear to grow well in localities with heavy rainfall, e.g., Senchal, and should be confined to such places as Tonglu, Sandakphu, etc., where the rainfall is comparatively low.

✓ ***Acacia catechuoides*** (Syn. *Acacia catechu*) (*Khair*).

1. *Locality.*—Riverain forests up to 1,000', prefers sandy soil such as river beds. Regenerates profusely on recently formed *chars*.
2. *Seed time.*—Flowers in August. Seeds ripen in January.



3. *Weight of seeds*.—1,100 clean seeds to the ounce; 127 pods to an ounce.
4. *Method of collection of seed*.—Collect ripe pods from the trees in January when they turn reddish black in colour.
5. *Method of treating seed*.—Spread pods in the sun for one or two days to dry before storing.
6. *Method of seed storage*.—Pods are stored in sacks till the end of May.
7. *Sowing (method and quantity of seed)*.—Best sown direct in lines. Pods are soaked in water for one or two days in May and then sown, there being no need to separate the seed.
8. *Germination (time, percentage, etc.)*.—Germination good; up to 70 per cent. Commences after a few days and continues for two weeks.
9. *Treatment in nursery*.—Not done.
10. *Method of transplanting*.—Difficult to transplant but stands root and shoot pruning.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—Gives little shade. If grown pure requires repeated climber-pulling. Should be grown in a mixture.
13. *Diseases and pests*.—Liable to attack from cattle, deer, porcupine, rhinoceros and elephants.
14. *Rate of growth*.—Growth is rapid during early years; up to 14' in three years.
15. *General remarks*.—

***Acacia lenticularis*** (Syn. *Acacia ferruginæ*). (*Kakur siris*—Nep.).

1. *Locality*.—Common west of the Tista in riverain forests on sandy loam. Also found in the *sal* and dry mixed plains forests in the Terai.
2. *Seed time*.—March-April. Best time for collection is middle April.
3. *Weight of seed*.—200 pods to the lb. 1,450 seeds to the lb.
4. *Method of collection of seed*.—Pods are collected from the tree. They turn a whitish brown indicating ripeness.
5. *Method of treating seed*.—Pods are dried in the sun until they open and seeds are extracted by hand. Seeds are then dried in the sun.

6. *Method of seed storage*.—Seeds are stored in sacks until ready for direct sowing in May.
7. *Sowing (method and quantity of seed)*.—Seeds are sown direct thickly in lines 6' apart in May. Thirty pounds of seeds are required per acre. As excellent results are obtained from direct sowing, nursery work does not appear necessary. If sown in the nursery, the seeds are sown thinly broadcast in April with a light layer of soil sprinkled over them. Shades are not necessary.
8. *Germination (time, percentage, etc.)*.—Germination excellent 80 per cent. Commences in a week and is complete within a month.
9. *Treatment in nursery*.—No special treatment except the standard method of weeding and watering. Pricking out is unnecessary.
10. *Method of transplanting*.—Transplanted entire with a handful of earth round the roots in early July of the first rains when about one foot high.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—Fast growing, and so requires little tending.
13. *Diseases and pests*.—
14. *Rate of growth*.—Fast growing. 3' in first year.
15. *General remarks*.—Should not be put out pure but should be suitable for mixing in alternate lines with slower growing shade bearers.

***Acer campbellii* (Kāpasi—Nep.).**

1. *Locality*.—Hill forests from 6,000' to 9,000'. This is one of the few species which is easy to grow at elevations about 7,000'. Natural reproduction of this species is good and comes up frequently in plantations.
2. *Seed time*.—Seeds ripen in November-December, best collected in December.
3. *Weight of seed*.—One pound of fruit gives 4½ ounces of clean seed. 650 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the tree by hand.
5. *Method of treating seed*.—Fruit is dried in the sun for a week and then thrashed.
6. *Method of seed storage*.—Seeds should be thoroughly dried and stored till February or March.

7. *Sowing (method and quantity of seed).*—Sow broadcast in shaded beds in nursery in March or April. One pound of seed per *kamra*. Has been sown in Darjeeling Division direct with success both in *thalis* 6' × 6' and in lines 6' apart.
8. *Germination (time, percentage, etc.).*—Seventy-five per cent. after 2 weeks.
9. *Treatment in nursery.*—Seedlings are pricked out, when 2" to 3" high in May-June. Plants should be kept in the nursery until the following rains.
10. *Method of transplanting.*—Transplanted entire, with or without any earth round the roots, 6' × 6' in *thalis* in June-July of the second rains. Should not be planted in dry and sandy soil. Winter planting (in January or February) with well-grown one year old seedlings when not in leaf is successful, seedlings get a good start in the spring and so get further ahead of the weed-growth, and thus casualties are reduced.
11. *Treatment after transplanting (weeding and cleaning).*—Two cleanings are usually required in the first year, and one or two in the second.
12. *Tending.*—
13. *Diseases and pests.*—Damage by game not severe.
14. *Rate of growth.*—At Mahaldaram, Kurseong Division, at an elevation of 6,700', the average rate of growth in plantations is as follows:—1st year—10"; 2nd year—1'—6"; 3rd year—5'—6"; 4th year—6'—8"; 5th year—7'—11". Sample plot No. 8 of Darjeeling Division at Simkona at an elevation of 7,000' gave a diameter of 7.5" and height of 51' in 36 years. Stem analysis of a tree at Bagora, Kurseong Division, at an elevation of 7,000' gave a girth of 6', height of 72', and a volume of 84 c. ft. down to 8" diameter in 82 years.
15. *General remarks.*—One of the few useful species that is easy to regenerate above 7,000', and should be put out more frequently at these elevations than has been done in the past.

***Acrocarpus fraxinifolius* (Mandane—Nep.).**

1. *Locality.*—Foot-hills up to 4,000', best around 2,000'. Regenerates itself easily in blanks and clear-felled areas.

2. *Seed time*.—Seeds in April-May. Best seed is obtained from the last week of April to the middle of May.
3. *Weight of seed*.—One pound of fruit gives 2 ounces of cleaned seed. 500 fruits to the lb. 900 seeds to the ounce.
4. *Method of collection of seed*.—Pods, when they appear black are collected from the tree by lopping branches. Sometimes collected from the ground.
5. *Method of treating seed*.—After collection the pods should be dried in the sun for 3 or 4 days on mats and the seeds beaten out with a stick.
6. *Method of seed storage*.—Seeds should not be stored long as they are liable to insect-attack.
7. *Sowing (method and quantity of seed)*.—Usually sown direct in lines of 6' apart or *thalis* 6'  $\times$  6'. Mixed line sowings in equal parts with seed of *chikrase* or *toon* (*Cedrela microcarpa*) is now the practice. Three bags of seed per acre is required. Suitable for broadcast sowing in burnt fuel coupes, as it is tolerant of shade and grows vigorously and hence requires little help against weeds and climbers. If sown in the nursery, it should be sown broadcast in shaded beds as soon as possible after collection. One pound of seed per *kamra* will suffice.
8. *Germination (time, percentage, etc.)*.—Germination good, 75 per cent., is complete in 2 or 3 weeks.
9. *Treatment in nursery*.—Watering should be done twice daily till germination and then every alternate day. The beds should be well weeded after germination. Prick out 3"  $\times$  3" into unshaded beds as soon as they are big enough to handle and transplant in June of the same year.
10. *Method of transplanting*.—Transplanted in *thalis*, 6'  $\times$  6', in June of the same year. Large plants can be transplanted with success. It is reported that stump planting is also successful.
11. *Treatment after transplanting (weeding and cleaning)*.—Tolerant of shade and pushes its way up easily. Therefore, requires little weeding or cleaning.
12. *Tending*.—Thinning is necessary when 3 to 5 years' old and thereafter every 5 years.
13. *Diseases and pests*.—Browsed by deer.

14. *Rate of growth*.—Fast. The following is the average rate of growth at Adma, Buxa Division, at 2,000' elevation:—1st year—4'; 2nd year—15'—8"; 3rd year—20'; 4th year—25'—6"; 5th year—32'—4".
15. *General remarks*.—This species grows very rapidly and being an intensive light demander tends to become widely spaced, and so should be grown in a mixture.

***Adina cordifolia* (Haldu—Hind., Karam—Nep.).**

1. *Locality*.—Foot-hills up to 3,000' on the west of the Tista river. Frequently found mixed with *sal* and prefers a good well-drained soil. Very common near the Mechi river, Kurseong Division, where trees of excellent growth are to be found. Also in the deciduous and mixed evergreen forests of Chittagong and Chittagong Hill Tracts. Excellent natural regeneration has been obtained in the clear-felled coupes after burning.
2. *Seed time*.—Seeds ripen in December-March. Best time to collect is February.
3. *Weight of seed*.—300,000 clean seeds to the ounce. Weight of heads 36 to the ounce. An ounce of heads gives about 16,000 clean seeds.
4. *Method of collection of seed*.—Heads are collected from the tree and seeds are so minute that it is very easy to collect heads which have already shed their seeds, so great care should be taken to collect ripe seeds and get heads which have not already shed seed. Heads turn yellowish black when ripe.
5. *Method of treating seed*.—After collection place the heads in the sun till dry and then break them up. An easy way to separate the seeds from the empty husks is to pour the mixed seed and husks into a can of water when the seeds will sink. The water and empty husks can be poured off and clean seeds remain.
6. *Method of seed storage*.—Not done.
7. *Sowing (method and quantity of seed)*.—Excellent results have been obtained by direct sowing in lines 6' apart and is probably the cheapest method. Seed should be mixed with ashes at the time of sowing in order to obtain the best results. Seeds should be sown in May before heavy rains break. Approximately 16 lbs. of heads per acre are required for direct sowing.
8. *Germination (time, percentage, etc.)*.—Germination is slow, takes about a month to complete germination with 50 per cent. success.

9. *Treatment in nursery*.—Choose coarse sandy soil and mix with sand and small stones. Spread straw or dry wood over the bed and burn it. This kills the seeds of weeds and gives a nice ash. Sow the seeds immediately after collection under shade on the ash, and water. Watering must be done very carefully with the finest possible rose or the tiny seeds will be washed away. The seedling is too minute to weed for some weeks after germination and weeds must be discouraged. To run an irrigation channel past a *karam* bed in the nursery is sufficient to cause failure, as the moisture will cause a crop of weeds in which no *karam* seedlings will survive.
10. *Method of transplanting*.—Transplanting of the bigger seedlings may be done in August of the first year when 3" high, smaller seedlings being left until the next June-July when about 10" in height. Winter transplanting of seedlings in their first and second cold weathers has given good results. Stump planting of plants in their second and third rains has also given good results.
11. *Treatment after transplanting (weeding and cleaning)*.—It will require frequent weeding for 3 rains, but it is thought that *karam* would prefer the light shade of woody species to a completely cleaned area. This does not mean that it should survive in an unweeded area, but simply that the cleanings of woody species need not remove every single plant, and that a little shade could act beneficially as a nurse. Experiments carried out in the Silvicultural Nursery and Garden at Hazarikhil, Chittagong, indicate that plants raised under all methods are healthier and percentage of survivals is higher when grown under a very light shade of *boga-medeloa*. A shade crop is not necessary in Northern Bengal.
12. *Tending*.—If *boga-medeloa* appears to be suppressing the plants it should be pruned back below the level of the plants in May just before the break of the rains.
13. *Diseases and pests*.—
14. *Rate of growth*.—Growth is slow at first. The average rate of growth is as follows:—1st year—2'; 2nd year—4'—6'; 3rd year—8'.
15. *General remarks*.—Prefers a light sandy loam and more of this species should be put out on suitable areas than has been done in the past.

**Ailanthus grandis** (Gokul—Nep.).

1. *Locality*.—A tall tree of the plains and lower hill forests up to 2,000'. Common in the foot-hills of Buxa east of the Jainti, foot-hills of Kalimpong Division and the Tista Valley. Soil well-drained sandy loam and should not be put out in areas where water is likely to lie during the rains. Regenerates itself well in blanks and open places where seedlings can get light.
2. *Seed time*.—January to the end of May. Best time to collect is middle of March to middle of April. Good seed year appears to take place every other year.
3. *Weight of seed*.—220 fruits to the lb. 35 clean seeds to the ounce. 1 lb. of fruit produces 4 ounces of clean seeds.
4. *Method of collection of seed*.—Fruits are usually collected from the tree by lopping branches. May also be collected from the ground but care must be taken not to collect insect attacked fruits. Fruits should be collected from the tree when they turn light brown.
5. *Method of treating seed*.—No special treatment is necessary and the fruits can be sown direct. When despatching seeds by Railway or Post, the wing on either side of the seed should be broken off by hand.  
• The fruits or seeds are dried in the sun for a few days after collection.
6. *Method of seed storage*.—Seeds are stored in sacks until ready for sowing in May-June. Seeds cannot be stored for the next year.
7. *Sowing (method and quantity of seed)*.—Direct sowing is the method recommended for raising *gokul*. Seeds should be sown in May-June thickly in lines 6' apart, there being two rows of seeds in each line and the seeds sown about 8" apart in the rows. 50 lbs. of seeds are required per acre for sowing direct in lines. If sown in *thalis* 6' x 6', 4 to 6 seeds should be sown per *thali*. If sown in the nursery the seeds are dibbled 3" x 3" in shaded nursery beds as soon after collection as possible. 2 lbs. of seeds are required per *kamra*.
8. *Germination (time, percentage, etc.)*.—Germination good, 60 per cent. Commences in a month and is complete within 4 months.
9. *Treatment in nursery*.—No special treatment except the standard method of weeding and watering. Pricking out is not necessary.

10. *Method of transplanting*.—Ball planting is recommended, plants being put out in early July of the first rains when about 6" high. Winter planting with balls of earth in the first cold weather has given excellent results. Stump planting of seedlings in July of the second rains when  $\frac{3}{4}$ " diameter at the collar has also been successful.
11. *Treatment after transplanting (weeding and cleaning)*.—Shade is not necessary.
12. *Tending*.—
13. *Diseases and pests*.—Damaged by deer.
14. *Rate of growth*.—Fairly fast growing. Rate of growth at Sukna in Kurseong Division is as follows:—1st year—1'; 2nd year—3'; 3rd year—6'; 4th year—9'—8". Stem analyses of a tree at Dumchi, in Madarihat Range, Jalpaiguri Division, at plains level gave a girth of 6'—6", height of 110', and a volume of 120 c. ft. down to 8" diameter in 38 years.
15. *General remarks*.—Reported to be a good wood for box-planking. Grows to a great height with a very small conical crown, and consequently the number of exploitable trees per acre should be much greater than with most of our miscellaneous species. Is easy to raise and quick-growing. It is therefore recommended that this species should be put out on as large a scale as possible on areas suited to it.

*Harra* <sup>*Hills*</sup> **Albizzia lebbek** (*Harra siris*—Nep.).

1. *Locality*.—Rare in Bengal. Trees are to be found at Chunabhati in Kurseong Division, and in the bungalow compound at Hazarikhil in the Chittagong Division.
2. *Seed time*.—January to March. Best time of collection is February. Excellent results have been obtained with seeds supplied by the Silviculturist, United Provinces.
3. *Weight of seed*.—400 pods to the lb. 350 clean seeds to the ounce.
4. *Method of collection of seed*.—Collected from the tree. Pods turn light brown when ripe.
5. *Method of treating seed*.—Pods are dried in the sun until they open, and seeds are extracted by hand. Seeds are then dried in the sun.
6. *Method of seed storage*.—Seeds are stored in sacks until ready for direct sowing in May.



7. *Sowing (method and quantity of seed).*—Seeds are sown direct thickly in lines 6' apart in May. 30 lbs. of seeds are required per acre. As excellent results have been obtained from direct sowing, nursery work does not appear necessary. If sown in the nursery the seeds are dibbled 3" apart in February or broadcasted thinly. Seeds are then covered with leaf-mould. Shades are not necessary.
8. *Germination (time, percentage, etc.).*—Germination excellent, 80 per cent. Commences in 4 days and is complete within 2 months. It is reported that soaking seeds for 48 hours in cold water before sowing increases the germination per cent.
9. *Treatment in nursery.*—No special treatment except the standard method of weeding and watering. Pricking out is not necessary.
10. *Method of transplanting.*—Transplanted with a handful of earth round the roots in early July of the first rains when about 1'–6" high.
11. *Treatment after transplanting (weeding and cleaning).*—
12. *Tending.*—Fast growing and so require little tending.
13. *Diseases and pests.*—
14. *Rate of growth.*—Fast growing.
15. *General remarks.*—A good timber. It is suggested that more of this species should be put out in alternate line mixtures with slower growing shade bearers.

***Albizzia marginata*** (Syn. *Albizzia stipulata*) (*Rato siris* or *Kalo siris*—Nep., *Tarli*—Beng.).

1. *Locality.*—Common in *khair* and *sissoo*, and mixed deciduous forests of the Duars and Terai, up to 3,000'.
2. *Seed time.*—December to March. Best time for collection is January. Seeds well every year.
3. *Weight of seed.*—83 pods to the ounce. 1,800 seeds to the ounce.
4. *Method of collection of seed.*—Pods are collected from the trees by lopping branches. Pods turn from green to brown indicating ripeness.
5. *Method of treating seed.*—Pods are dried in the sun until they open and seeds are extracted by hand. Seeds are then dried in the sun for a few days.
6. *Method of seed storage.*—Seeds are stored in sacks until ready for direct sowing in May.

7. *Sowing (method and quantity of seed).*—Seeds are sown direct thickly in lines 3' apart in May. 30 lbs. of seeds are required per acre. As excellent results are obtained from direct sowing, nursery work does not appear necessary. If sown in the nursery, seeds are sown thickly broadcast in January with a light layer of soil sprinkled over them. Shades are not necessary. 3 ounces of seeds are required per *kamra*.
8. *Germination (time, percentage, etc.).*—Germination fair, 50 per cent. Commences in two months and is complete within six months.
9. *Treatment in nursery.*—No special treatment except the standard method of weeding and watering. Pricking out is unnecessary.
10. *Method of transplanting.*—Plants are transplanted with a handful of earth round the roots in early July of the first rains when about 8" high. Winter planting with balls of earth in the first cold weather has been successful. Stump planting of two-year old seedlings is also successful.
11. *Treatment after transplanting (weeding and cleaning).*—Fast growing and so requires little tending.
12. *Tending.*—
13. *Diseases and pests.*—
14. *Rate of growth.*—The following is the rate of growth from direct sowing in plantations at Sukna, Kurseong Division:—1st year—1'—4"; 2nd year—4'—0"; 3rd year—9'—0". The table below gives the comparison in height growth of direct sowing, ball, winter and stump plantings carried out in the Silvicultural Garden at Sukna, Kurseong Division—
 

| Method.                                      | Age.         | Height. |
|--|--------------|---------|
| 1. Direct sowing (May)                       | ... 3 years. | 9'—0"   |
| 2. Ball planting (June).                     | ... 3 years. | 8'—0"   |
| 3. Winter planting (December).               | ... 3 years. | 5'—0"   |
| 4. Stump planting with 2 years old seedlings | ... 2 years. | 5'—0"   |
15. *General remarks.*—Should not be put out pure and should be suitable for alternate line mixtures with slower-growing shade bearers.

**Albizzia procera** (*Safed* or *Seto siris*—Nep., *Koroi*—Beng.).

1. *Locality*.—In Northern Bengal is found near river beds in the plains. In the three Chittagong Divisions occurs in the dry and open deciduous type of forests preferably on western and southern aspects. Frequently found in abandoned *jhum* areas and along the banks of streams and lower slopes of the hills. Soil sandy to sandy loam and must be well-drained. Elevation up to 300'.
2. *Seed time*.—Seeds ripen end of January to the middle of March. Best time to collect in Northern Bengal is in March.
3. *Weight of seed*.—1 lb. of pods give 4 ounces of clean seeds. Northern Bengal reports 680 seeds to the ounce and Southern Bengal 550.
4. *Method of collection of seed*.—Pods are collected from the trees by cutting off branchlets. Is sometimes collected from the ground when freshly fallen, but it is more advisable to collect from the tree. Pods turn black when ripe.
5. *Method of treating seed*.—Pods are dried in the sun for a few days until they open and seeds are removed either by hand or by gentle thrashing. It is reported that soaking seeds in hot water immediately before sowing will give quicker and more even germination.
6. *Method of seed storage*.—Seeds if stored carefully in sacks in a dry well-ventilated shed can be kept for at least a year. It is advisable to spread the seeds out on mats occasionally to air, otherwise they will become mildewed.
7. *Sowing (method and quantity of seed)*.—In Northern Bengal excellent results have been obtained by direct sowing in lines 6' apart. Is also a useful species for broadcasting in burnt fuel coupes as it is a fast grower. In Southern Bengal has been tried experimentally in plantations and is sown direct as mentioned above, in May-June, the seeds being covered with a thin layer of earth. If sown in the nursery, is sown in unshaded beds in May. Two ounces of seeds are required for a *kamra*, seeds being spaced 3" x 3".
8. *Germination (time, percentage, etc.)*.—Germination commences in 3 or 4 days in the nursery, and in a week in the plantations, and continues up to 3 weeks in both. Gives about 70 per cent. germination.
9. *Treatment in nursery*.—No special treatment required except light watering for about a week. Leaf mould manuring will certainly help but is not essential.

10. *Method of transplanting.*—If sown in May the plants will be 5" to 6" in height in July and ready for transplanting. Transplanted entire with or without a handful of earth round the roots immediately after removal from nursery beds and preferably on wet days. Transplanting does not appear difficult but direct sowing is obviously the cheapest and most successful method. Stump-planting with one or two year old nursery plants has given cent. per cent. success and is very useful for filling up vacancies.
11. *Treatment after transplanting (weeding and cleaning).*—
12. *Tending.*—In the Chittagong district, soil should not be unduly exposed when weeding and only weeds actually interfering with plants should be removed, the remainder being left to shade the ground during the hot weather. Climber-pulling should be done when necessary.
13. *Diseases and pests.*—Caterpillars attack young leaves and young plants are often defoliated. Suffers very badly from browsing by deer and even large saplings are eaten down to almost bare sticks. For this reason this species should not be put out in unfenced plantations that are liable to attacks from deer. Several small experimental plantations both in Chittagong and Cox's Bazar Divisions have been completely wiped out by deer within their first 2 years of formation.
14. *Rate of growth.*—The following measurements represent the average rate of growth in plantations in the Chittagong district:—1st year—1'; 2nd year—2'—6"; 3rd year—6'; 4th year—10'; 5th year—15'.
15. *General remarks.*—Is reported to be a good furniture wood and for this reason more of this species should be put out, preferably in alternate lines with slower growing shade-bearers.

***Alnus nepalensis* (Utis—Nep.).**

1. *Locality.*—2,000' to 6,500'. Gives good natural reproduction on landslips. Is usually found in shaded hollows near small *phorus*.
2. *Seed time.*—Seeds December-January.
3. *Weight of seeds.*—1 lb. of fruit gives 2 ounces of cleaned seed. 16,000 seeds to the ounce.
4. *Method of collection of seed.*—Fruits are collected from the trees by lopping branches.

5. *Method of treating seed.*—Fruits are then dried in the sun and seeds extracted by beating with sticks.
6. *Method of seed storage.*—The seeds are stored in tins and can be kept for 3 or 4 months.
7. *Sowing (method and quantity of seed).*—Broadcast in March in shaded, well-manured nursery beds. 8 ounces of seeds are required for one *kamra*. Seed beds are sometimes covered with brushwood to hasten germination.
8. *Germination (time, percentage, etc.).*—Time taken to germinate depends on the elevation. The lower the elevation, the quicker the germination. As a rule slow to germinate, from 4 to 6 weeks. Germination up to 70 per cent. is reported.
9. *Treatment in nursery.*—Sow in March in shaded, well-manured beds. Above 5,000', seeds germinate in May and are pricked out in July and August and planted out the following rains. Below 5,000' seedlings can be pricked out under shade in May, and be put out in June or July of the same year, and if sown thinly, may be planted out direct from the seed-bed. The experiment of putting the nursery at a lower elevation than the area to be planted with a view to forcing the plants has been tried, but results have not been recorded. Shades may advantageously be removed from the pricking out beds after the plants have been in them for a short time. In the case of plants kept in the beds throughout the cold weather, shades must be replaced when danger from frost and hail arises.
10. *Method of transplanting.*—Transplanted entire at the beginning of the 1st or 2nd rains when 6" to 2' in height with or without a handful of earth round the roots. Autumn and winter planting in September to January with seedlings of their first year may be done in damp and misty localities but is not recommended on dry aspects or at high elevations. Such seedlings will only be about 6" high, and should have all their leaves removed, except the leading shoot at the time of transplanting. Natural seedlings 6" to 9" in height have been transplanted into plantations entire without balls of earth in July and gave 75 per cent. success. Should never be put out pure but mixed in alternate lines with slower growing shade-bearers.
11. *Treatment after transplanting (weeding and cleaning).*—
12. *Tending.*—A quick grower and so no tending is required after the 3rd year. The age at which the first thinning should take place depends on the elevation and aspect,

but as a general rule should be carried out when 5 years old and thereafter every 5 years. Thinning of this species has been the subject of a separate note.

13. *Diseases and pests*.—Damage is caused by snow-break, frost, and grazing. It is also attacked by a species of Lepidopterous larva, which girdles the young tree and may kill the top or the whole tree above the portion of the girdle. Is also attacked by the stem borers *Batocera horsfieldii* and *B. numitor*, whole *utis* plantations at Phuaguri, Kurseong Division, have been wiped out by these pests. A Chrysomelid beetle (*Chrysomela chlorina* Mlk.) has been found to defoliate young *utis* plants. Shoots borers (*Pyralidæ*) attack the green shoots and *Phassus auratus* the woody twigs.
14. *Rate of growth*.—Fast. At Paeongaon, Kalimpong Division, at an elevation of 6,000' the average rate of growth in plantations is as follows:—1st year—1'—9"; 2nd year—3'—2"; 3rd year—10'; 4th year—16'—1"; 5th year—24'—2". Sample Plot No. 17 of Kurseong Division at Bagora at an elevation of 6,450' gave an average diameter of 6.2", and height of 58' in 10 years. Stem analysis of a tree at Rangirum, Darjeeling Division, at an elevation of 6,300' gave a girth of 6'—2", height of 102' and volume of 100 c.ft. down to 8" diameter in 34 years. Temporary Sample Plot No. 1 of Darjeeling Division at Lopchu at an elevation of 5,000' gave an average diameter of 20.4", height 124', and a timber volume of 4,250 c.ft. per acre down to 8" diameter in 38 years.
15. *General remarks*.—*Utis* is a transitory crop that is only to be found pure to any extent on land slips, and observations show, that for no apparent reason whole crops often die out before the trees attain a useful size. Again it has been noticed in many of our pure *utis* plantations, especially those put out on spurs and ridges that after the first few years of rapid growth trees look unhealthy, growth slows down and many are to be found dying off. In the natural forest *utis* of any size is only to be found scattered in shady ravines and damp hollows near springs and streams. The writer is of the opinion that *utis* should therefore only be put out in shady ravines and damp hollows and that its place in future plantations should be taken by species such as *birch*, *toon* which form a permanent crop in the natural forest. *Utis* should never be put out pure but should be mixed in alternate lines with slower growing shade-bearers, such as *chañp* (*Michelia excelsa*), *phurre chañp* and *Machilus* spp.

***Alstonia scholaris* (Chatiwan—Nep. and Beng.).**

1. *Locality*.—Occurs sporadically in *sal* and mixed forests in the plains and foothills of Northern Bengal. Also in the forests of Chittagong and Chittagong Hill Tracts. Appears to do best on a deep moist soil. *Regenerates itself naturally under suitable conditions.*
2. *Seed time*.—Last week of March to first part of April. Best time for collection is the first week of April. Seed years are irregular.
3. *Weight of seed*.—350 pods to the lb. 7,600 seeds to the ounce. 3 lbs. of pods produce 1 ounce of clean seeds.
4. *Method of collection of seed*.—Fruits are collected from the tree by lopping branches. Black or deep brown colour of the pod indicates ripeness. Pods should be collected when one or two are found to be opening on the tree. Care should be taken when collecting, otherwise pods will open and seeds will fall out.
5. *Method of treating seed*.—Pods are dried in the sun for a day or two to hasten opening. This should be done in a sack or pods should be covered with a cloth to prevent seeds being blown away. Pods are then put in a closed room and beaten gently with a stick until the seeds come out.
6. *Method of seed storage*.—Seeds required for direct sowing are stored in sacks until May.
7. *Sowing (method and quantity of seed)*.—Direct sowing is the method recommended for raising *chatiwan* and results are better than transplanting. Direct sowing is done in May in lines 4' to 6' apart. 8 lbs. of clean seeds are required per acre for direct sowing in lines 4' apart. In the nursery the seeds are sown broadcast in shaded beds in April. About 8 ounces of clean seeds are required per *kamra*. Seeds should be mixed with powdered earth before sowing either direct or in the nursery to avoid germinating in clumps.
8. *Germination (time, percentage, etc.)*.—Germinates after a fortnight.
9. *Treatment in nursery*.—No special treatment except the standard method of weeding and watering. Pricking out is not necessary.
10. *Method of transplanting*.—Transplanted with a handful of earth round the roots in June when about 3" high.
11. *Treatment after transplanting (weeding and cleaning)*.—Observations show that plants look healthier when under a light cover of *paddy*. This would indicate that heavy cleanings should not be done and that a

light shade of woody species might act beneficially as a nurse.

12. *Tending*.—
13. *Diseases and pests*.—None noticed yet.
14. *Rate of growth*.—2'—6" in the second year.
15. *General remarks*.—A good match wood.

Amoora wallichii (*Lali*—Nep., *Pitraj*—Chitg.).

1. *Locality*.—Found in *sal* and mixed forests in the plains of Northern Bengal. A good shade-bearer. Thrives in moist areas where water does not accumulate. Common in the evergreen forests of the Chittagong district, where it regenerates itself very easily.
2. *Seed time*.—Flowers October–November. Seeds May to 2nd week of July, best seed is obtained during mid-June to mid-July.
3. *Weight of seed*.—3 lbs. of fruits give 1 lb. of clean seed. 60–70 seeds to the lb.
4. *Method of collection of seed*.—It is preferable to collect fruits from the trees than from the ground, but difficult to collect as only the larger trees bear fruit and they are very tall.
5. *Method of treating seed*.—Fruits are dried in the sun which causes them to open. The seeds are then removed from fruits by hand, washed and dried.
6. *Method of seed storage*.—Best to sow directly after collection.
7. *Sowing (method and quantity of seed)*.—If sown in the nursery seeds are dibbled with the long axis horizontal 6" × 6" in June after collection. Shades are not required. Direct sowing in *thalis* has proved better than transplanting, as the seeds in the nursery are badly attacked by rats and also as transplanting appears to check the growth very much; 2-year old plants from direct sowing averaged 5'—6", best 8'—4", while transplants of the same age averaged 3'—0", best 5'—5". Direct sowing in lines has not been tried but should be preferable to sowing in *thalis*.
8. *Germination (time, percentage, etc.)*.—In shaded beds, germination good, 85 per cent., and takes place from 10 to 20 days. In unshaded beds, germination is poor and only up to 35 per cent. reported.
9. *Treatment in nursery*.—When dibbled 6" × 6", no pricking out is required.



10. *Method of transplanting*.—Transplanting of one year old or even 2 years old seedlings from nursery beds in the latter part of June and July has proved successful, but growth appears to be checked by transplanting. Seedlings have also been collected from the natural forest and put out in the plantation. Success up to 80 per cent. in the latter method has been reported. While collecting, *lahasune* (*Amoora rohituka* and *Dysoxylum spp.*), seedlings are often mistaken for *lali*, but it appears that the leaves of *lali* seedlings are darker than *lahasune* at this stage. Ball-planting or at least planting with a handful of earth round the roots is recommended.
11. *Treatment after transplanting (weeding and cleaning)*.  
A slow grower for the 1st year and will need several cleanings during the 1st rains.
12. *Tending*.—
13. *Diseases and pests*.—The bark is attacked by the larva of the moth *Prasioxena monospila* Meyr (*Pyralidae*). It eats the bark in a spiral formation and the tree may become completely girdled in several places. A plantation at Rajabhatkhawa was practically entirely destroyed by this pest when 8 years old. A species of a longicorn larva (*Monochamus*) was found in the pith of one of the young plants killed by the pest mentioned above. Fruits are badly damaged by rats and monkeys. The shoot-borer *Hypsipyla robusta* attacks the leading shoots. The bark of young saplings is very badly damaged by deer.
14. *Rate of growth*.—Grows quite fast from the 2nd rains. Average height of transplants at the end of the 1st rains 1'—6", at the end of the 2nd 4'—0", while plants from direct sowing averaged 5' to 6' at the end of the 2nd rains.
15. *General remarks*.—Suitable for putting out in areas too wet for *sal* and for filling up blanks in *sal* plantations. Its growth is about the same as *sal*, and as it grows straight up with a small compact crown, so when isolated, does not over-top the *sal* in its surrounds. Useful for filling up blanks in plantations of the current year with direct sowing when no nursery plants are available, as the best seed is usually found comparatively late.

\* *Anisoptera glabra* (Boilam Chitg.).

*Locality*—Occurs sporadically in the mixed evergreen forests of the three Chittagong Divisions, and in small pure patches in the Sungoo and Matamori reserves

where the species attains a very large size. On the cooler aspects of slopes and ridges. Soil sandy loam to loam, moist, deep and fertile, elevation up to 750'.

2. *Seed time*.—April-May, the best time of collection being towards the middle of May.
3. *Weight of seed*.—270 fresh seeds with wings to the lb.
4. *Method of collection of seed*.—The winged seeds when ripe fall to the ground and are collected.
5. *Method of treating seed*.—
6. *Method of seed storage*.—To be sown immediately after collection. Seeds cannot be stored and lose their power of germination in a very short time.
7. *Sowing (method and quantity of seed)*.—Has been sown experimentally on a small scale at Bhomariaghona in the Cox's Bazar Division. Sowing was done direct in lines 6' apart, 2 rows of seeds in each line, the seed being 6" apart in the rows; and also at stake 6'×6', 4 to 6 seeds at a stake. Seeds are laid on their edges with their wings sticking up (like *sal* or *gurjan*) with a soil covering up to the depth of the thickness of the smallest diameter of the seed. Five bags of seeds are required for sowing up an acre in lines 6' apart. The results of direct sowing are extremely poor and ball planting only is recommended. In the nursery should be dibbled 3"×2" under shade, 3 lbs. of seeds per *kumra* will suffice.
8. *Germination (time, percentage, etc.)*.—Germination starts in 2 weeks and is complete from 4 to 6 weeks. Germination per cent. is usually very poor; 20 per cent. from direct sowing, and up to 35 per cent. in shaded beds in the nursery has been recorded.
9. *Treatment in nursery*.—Watering should be sparsely done as plants appear to damp off easily. This species grows a fairly large tap root and is therefore rather difficult to transplant. Pricking out should be done as soon as plants are big enough to handle.
10. *Method of transplanting*.—Transplanted successfully in in July-August of the same year when plants are 5" to 6" high. Is an extremely sensitive plant and ball-planting is recommended. Should only be transplanted on a dull day and when rain is expected. Transplanting of seedlings from the natural forest with balls of earth has been done very successfully, up to 75 per cent. survivals being reported.
11. *Treatment after transplanting (weeding and cleaning)*.—

12. *Tending*.—This species does not appear to stand drought and many plants both from direct sowing and transplanting are killed off especially during the first hot weather. It is suggested that *bogamedeloa* should be grown between the lines and be treated exactly as laid down for *gurjan*. Cleaning should not be done during the cold and hot weathers as the soil should not be exposed, and weeds unless they are actually interfering with the plants should be left to shade the ground. Climber-pulling should be done when necessary.
13. *Diseases and pests*.—A large percentage of seeds are found to be attacked by insects which burrow into them. In the nursery young plants have been attacked by grubs and killed. In the hot weather of the first year leaves often turn yellow and a large percentage of plants die off.
14. *Rate of growth*.—Very slow. 1st year—8"; 2nd year—1'—3"; 3rd year—2'.  
Stem analysis of a tree at Machuakhali, Garjanja Range, Cox's Bazar Division, gave a girth of 6'—10", height of 90', and a volume of 86 c. ft. down to 8" diameter in 87 years.
15. *General remarks*.—This species has only been experimented with on a small scale and information given here is more often than not the result of few observations. There is a difference of opinion as to whether direct sowing or transplanting is the best. When germinating the shoot grows with a coil in it, this in the nursery straightens out after about 2 months, whereas plants by direct sowing were still coiled after 8 months and were much smaller and looked more unhealthy than those in the nursery; on the other hand transplanting appears to be difficult and the casualties even after ball-planting are sometimes heavy. Taking everything together ball-planting is recommended. It suffers from drought and should only be put out on lower slopes on the cooler north and east aspects.

***Anthocephalus indicus*** (Syn. *Anthocephalus cadamba*) (Kadam in all vernaculars).

1. *Locality*.—Plains and foot-hills of Northern Bengal up to 3,000', also in the three Chittagong Divisions.
2. *Seed time*.—Seeds August-September (occasionally as late as December). Best time to collect is middle to latter part of August.
3. *Weight of seed*.—26,100 seeds per ounce.

4. *Method of collection of seed.*—Fruits are collected from the ground.
5. *Method of treating seed.*—Fruit is collected and heaped under shade and allowed to rot for 3 or 4 days. The pulp is washed off by hand in a bucket of water, and as the seed sinks it is easily separated from the pulp. Seeds should then be dried.
6. *Method of seed storage.*—Seeds, if thoroughly dried, may be stored in a dry place until required next year.
7. *Sowing (method and quantity of seed).*—Direct sowing appears to be difficult and many failures are recorded. This is probably due to the collection of immature seed. In the nursery sow seeds in shaded beds in February. 2 lbs. of seed per *kamra* will suffice. It is advisable to keep the seeds until February, as, if sown directly after collection, the plants will be too big to put out at the beginning of the rains. Sowing should be done thinly when no pricking out will be necessary.  
It is not usually put out in plantations, but is extremely useful for broadcasting in fuel coupes owing to its rapid growth. When grown in plantations it is sown broadcast direct in lines 6' apart in May-June.
8. *Germination (time, percentage, etc.).*—Percentage fair. It germinates in 3 weeks.
9. *Treatment in nursery.*—
10. *Method of transplanting.*—Transplanted entire with a handful of earth round the roots in the first June-July in *thalis* 6' × 6'. Has been put out successfully as root and shoot cuttings. Natural seedlings have been collected from the forest in August when about a foot high and transplanted entire without balls of earth with cent. per cent. success. Winter transplanting has not been successful.
11. *Treatment after transplanting (weeding and cleaning).*—
12. *Tending.*—Requires little tending and pushes its way through weeds easily.
13. *Diseases and pests.*—
14. *Rate of growth.*—It is probably the fastest growing tree in the plains, giving a girth increment of about 6" per annum up to the 9th year.
15. *General remarks.*—Gives profuse natural regeneration and comes up naturally in young plantations. As it may suppress the planted species it should be uprooted while still small.

**Artocarpus chaplasha** (*Lathar—Nep., Chama or Chapalish—Beng.*).

1. *Locality*.—Plains and hills up to 3,000'; also in the forests of the three Chittagong Divisions. Regenerates well in the evergreen forests of the Chittagong Hill Tracts.
2. *Seed time*.—Last week of June to the first week of August. Best time of collection is the end of July.
3. *Weight of seed*.—1 lb. of fruit gives 2 ounces of clean seeds. 50 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are usually collected from the ground, care being taken not to collect seed that has been damaged by insects, etc.
5. *Method of treating seed*.—The pulp is allowed to rot, then washed in a bucket of water, and as the seed sinks it is easily separated from the pulp.
6. *Method of seed storage*.—Cannot be stored.
7. *Sowing (method and quantity of seed)*.—The method recommended for raising *chapalish* is by dense line sowings with *boga-medeloa*. The combination of dense line sowings and *boga-medeloa* forces the plants up to the light and the rate of growth in the first few years is much faster than when grown in *thalis*. Seeds should be sown within 3 days after collection, two rows of seed in each line, the seeds being 8" apart in each row. In Southern Bengal it is essential that the *boga-medeloa* should be put out in the same year as the *chapalish* in order to afford shade to the young seedlings during the first hot weather. With *taungya* crops the *boga-medeloa* is sown thickly broadcast at the time of the last cleaning of the *paddy* in August and any blanks are resown in September after the *paddy* has been reaped. If sown later than August the *boga-medeloa* will not be tall enough to afford shade to the young *chapalish* during the first hot weather. In regular plantations *boga-medeloa* is sown in 1' wide lines in May of the first year. In Northern Bengal the *boga-medeloa* can be sown either in the same year as the *chapalish* or the following May. If sown in *thalis* 6' x 6', 4 to 6 seeds should be sown per *thali*. In the Chittagong district *chapalish* does best on shaded north and east aspects but provided the shade crop is kept dense for the first two years, it does quite well on the more exposed south and west aspects. Requires a well-drained soil and should not be put out

on areas that are even inclined to be water-logged. If sown in the nursery, should be dibbled in shaded beds 3" x 3". When sowing in the nursery, seeds should be collected as early as possible so as to have plants large enough to put out during the same rains, otherwise they will have to remain in the nursery for a year. Shades are essential. It is reported that germination in shaded beds is up to 80 per cent., and in unshaded beds only 40 per cent.

8. *Germination (time, percentage, etc.)*.—Good, up to 80 per cent. Starts germinating from 7 to 12 days, and is complete within 14 days.
9. *Treatment in nursery*.—If plants are to be kept in the nursery for a year, pricking out is recommended as soon as they are big enough to handle.
10. *Method of transplanting*.—Transplanted usually with balls of earth, and occasionally with a handful of earth round the roots, in *thalis* 6' x 6' in the first or second rains. Root and shoot cuttings have been successful with plants too big for transplanting. *Boga-medeloa* should be sown in between the lines of *thalis* in the 1st year.
11. *Treatment after transplanting (weeding and cleaning)*.—In the Chittagong district it is desirable not to expose the soil when cleaning the lines or *thalis* and only climbers, and weeds actually interfering with the growth of the plants should be cut, the remainder being left to shade the soil during the coming hot weather.
12. *Tending*.—If it is found that the *chapalish* is being suppressed, all that is necessary is to cut back the branches of *boga-medeloa* overtopping the lines. If this is not sufficient thinning to single stems may be done just before the break of the second or third rains. *Boga-medeloa* found actually in the *chapalish* lines should be pulled up.
13. *Diseases and pests*.—Squirrels and rats eat the seed. Monkeys year after year pull off the new shoots in young plantations. Is often badly attacked by a shoot-borer but usually recovers as in the case with *toon*. Browsed by deer and cattle. Badly damaged by elephants, even thirteen year old saplings have been uprooted. Therefore, should not be put out in areas which are frequented by elephants, which limits the

area in Chittagong district to the Ramgarh-Sitakund and South Sitakund Ranges in the Chittagong Division, and Ringkheong in the Chittagong Hill Tracts Division.

14. *Rate of growth*.—Rapid from the second rains. At Hazarikhil in the Chittagong Division, the average rate of growth in plantations is as follows—1st year—2'; 2nd year—4'—6"; 3rd year—8'; 4th year—12'; 5th year—17'.

Sample Plot No. 7 of Chittagong Division at Hazarikhil, at plains level, gave an average diameter of 5.6", height of 43', in 10 years.

Stem analysis of a tree at Mainimukh, Chittagong Hill Tracts Division, gave a girth of 8'—6", height of 119', and a volume of 147 c. ft. down to 8" diameter in 96 years.

15. *General remarks*.—As this species seeds late, it is useful for filling up blanks by direct sowing in the current year's plantation, when no nursery plants are available. It is a shade-bearer, and is a suitable species for under-planting. Should be useful for growing in a mixture with light-demanders. It may be said that this method of dense line sowings in conjunction with *boga-medeloa* is unnecessarily expensive. But experience has shown that besides its use in affording the necessary shade to young plants, any extra cost is more than fully compensated for by the reduced number of cleanings necessary especially in Southern Bengal where *assamlota* is the principal weed. In Northern Bengal is a useful species for putting out in areas where there are no *taungya* villagers, i.e., in regular plantations as no field crop is required, and *boga-medeloa* can be sown in April of the first year before transplanting.

#### ***Artocarpus integrifolia* (Kanthal—Beng.).**

1. *Locality*.—Cultivated all over Bengal. Known as the "Jack fruit" tree. Has at present only been tried on a small scale in the Chittagong district. Prefers loamy soil.
2. *Seed time*.—May to July.
3. *Weight of seed*.—20 seeds to the lb.
4. *Method of collection of seed*.—Collected from the tree when fruits are ripe.

5. *Method of treating seed.*—Fruits are split open, the seeds are then separated from the pulp by washing and then dried.
6. *Method of seed storage.*—Seeds cannot be stored long and best sown immediately.
7. *Sowing (method and quantity of seed).*—So far only direct sowing in *thalis* has been done, 3 to 4 seeds in each *thali*.
8. *Germination (time, percentage, etc.).*—Germination good, 75 per cent.
9. *Treatment in nursery.*—Not tried.
10. *Method of transplanting.*—Not tried.
11. *Treatment after transplanting (weeding and cleaning).*—
12. *Tending.*—*Boga-medeloa* has been tried in the Chittagong Division as a shade crop, but under its shade *kanthal* was found to be suppressed. On removing *boga-medeloa* it immediately responded. From this it appears that a shade crop is definitely harmful to this species.
13. *Diseases and pests.*—Very badly browsed by deer and up to the present every plantation tried with this species has in the end been completely destroyed. For this reason it should not be put out unless the plantations are fenced against deer.
14. *Rate of growth.*—Growth fairly rapid. At Hazarikhil in the Chittagong Division the average rate of growth in plantations is as follows:—1st year—1'—2"; 2nd year—3'; 3rd year—7'.
15. *General remarks.*—

***Betula alnoides*** (*Birch*—Eng.; *Lekh-saur*—Nep.).

1. *Locality.*—Middle hill forests from 5,000' to 8,000'. Common around Darjeeling especially near Birch Hill, the middle hill forests of Tonglu and Singalila Ranges of Darjeeling Division, and in Pankhasari Range, Kalimpong Division. Good regeneration occurs especially on land slips and in open places. This species is known as the higher level *birch* as opposed to the two species *cyindrostachys* and *acuminata* which seldom occur above 6,000'.
2. *Seed time.*—End of April to the beginning of June, depending on elevation.



3. *Weight of seed.*—385 fruits to the ounce. 265,952 seeds to the ounce.
4. *Method of collection of seed.*—Fruits are collected from trees by lopping branches. Fruits turn black as an indication of ripeness. Fruits are dried in the sun and then broken up with a stick. Seeds are separated by winnowing.
5. *Method of treating seed.*—No treatment is necessary.
6. *Method of seed storage.*—Seeds can be stored in a well-ventilated room for several months.
7. *Sowing (method and quantity of seed).*—Sown broadcast in shaded nursery beds immediately after collection after mixing with ashes or powdered earth. In some Ranges seeds are stored until September, in order to have smaller plants at the time of transplanting in the following June-July. This is not considered necessary with this species, as opposed to the species *cylindrostachys* and *acuminata*, it is extremely hardy and can be put out easily as large plants. The bigger the plants put out the better as they are sooner above the weed growth. 8 ounces of seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.).*—Germination commences in 9 days and is complete within 5 weeks giving about 15 per cent. success.
9. *Treatment in nursery.*—Standard methods of weeding and watering should be carried out. As plants will be kept in the nursery bed until the second rains pricking out should be done 3' x 3" in August as soon as the plants are big enough to handle. Experiments have shown that at the time of transplanting the roots of pricked out plants were bushy and easy to handle while those unpricked had long tap roots and were difficult to plant.
10. *Method of transplanting.*—Should be transplanted 6' x 6' with a handful of earth round the roots in June-July of the second rains when about 2' high, such transplants gave 80 per cent. success. Cold-weather transplanting of 7 and 19 months old seedlings after stripping the leaves gave over 90 per cent. success in each case. This is an extremely hardy plant and providing reasonable care is taken at the time of planting this species can be put out at any size up to 3' high. Natural seedlings 2"—4" in height have been transplanted from the forest direct with 60 per cent. success.

11. *Treatment after transplanting (weeding and cleaning).*—Weedings and cleanings are necessary for 2 or 3 years.
12. *Tending.*—After 3 years the canopy is complete and little tending is required. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests.*—Is frost-hardy. Browsed by deer. Is attacked by a defoliator.
14. *Rate of growth.*—Fairly fast, more so than the species *cylandrostachys* and *acuminata* in the younger stages, although the latter appears to grow into a bigger tree. The rate of growth in plantations at Takdah, Darjeeling Division, at an elevation of 5,000', is as follows:—1st year—2'; 2nd year—4'; 3rd year—6'. Sample Plot No. 24 at Algarah, Kalimpong Division, at an elevation of 5,500', gave an average height of 70', diameter of 6.0" in 19 years. Stem analysis of a tree at Dumsong, Kalimpong Division, at an elevation of 6,000', gave a girth of 6'—4", height of 105', and a volume of 79 c.ft. down to 8" diameter in 50 years.
15. *General remarks.*—As this species is much hardier and easier to put out than either of the species *cylandrostachys* and *acuminata*, it is suggested therefore that if seed is available it should be put out in preference to the other two. Has been reported on by Dehra Dun as an excellent utility timber and more of this should be put out in future. It should be used to replace *utis*, as explained in paragraph 15 under *Alnus nepalensis*. Should not be put out pure but in alternate lines with slower growing shade-bearers.

***Betula alnoides* Var. *cylandrostachys* and Var. *acuminata***  
(Birch—Eng., Aule-saur—Nep.).

1. *Locality.*—Foot-hills up to 6,000'. Especially common around Latpanchar, Kurseong Division, parts of Pankhasari Range, Kalimpong Division, and in the Tista Valley. Good regeneration occurs especially on land slips and in open places. These two species of *birch* are known as the low-level *birch* as opposed to *Betula alnoides* known as the high-level *birch*, which very seldom occurs below 5,000' and goes up to 8,500'.
2. *Seed time.*—Seeds latter half of January to middle of March.

3. *Weight of seed*.—1 lb. of fruit gives 1 ounce of clean seeds. 388,500 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the tree by lopping the branches, dried in the sun for a week and then broken up with a stick. Seeds are separated by winnowing.
5. *Method of treating seed*.—No treatment is necessary.
6. *Method of seed storage*.—The clean seed can be stored in a well ventilated room for several months.
7. *Sowing (method and quantity of seed)*.—The practice in the past was to sow seeds immediately after collection and to keep plants in the nursery until the second rains and put out when about 2' high. Plants so tall were found to be very delicate, and with the greatest care not more than 20 to 40 per cent. survivals were recorded. What is required is to have plants of a suitable size for transplanting in the rains. There are two methods of doing this—
  - (i) To store the seeds and sow in September. This will give plants about 9"—1' high in the following June.
  - (ii) To sow seeds immediately after collection, and to use every aid available to force the growth of plants in order to get seedlings as tall as possible from 2"—3" to put out in the first July-August.

Seeds should be broadcasted thinly in shaded beds in the nursery and should be mixed with ashes or powdered earth to avoid germinating in clumps. 8 ounces of seed per *kamra* will suffice. Has been sown broadcast direct with success in Kalimpong Division on ground that was comparatively level. A thin layer of earth should be spread over the seeds after broadcasting to prevent the seeds being blown away.

8. *Germination (time, percentage, etc.)*.—Germination is complete within 2 months and gives about 10 per cent. success.
9. *Treatment in nursery*.—When seeds are sown in the nursery immediately after collection, and the object is to get seedlings large enough say from 2"—3", to put out in the first July-August certain aids to germination and growth must be carried out as follows:—
  - (i) Nursery beds may be put at a lower elevation than the planting area so as to accelerate germination.

- (ii) Seed-beds should be heavily manured. 4 ounces of slaked lime per square yard has proved very beneficial. As lime is apt to burn and injure roots of the growing plants it should be applied when beds are empty, about 6 weeks before sowing.
- (iii) Brushwood or thatch may be spread over the bed to hasten germination.

Standard method of weeding and watering. Shades are to be removed from beds after germination is complete. No pricking out is necessary with seedlings raised by seed sown immediately after collection, and which are to be put out in the first July-August when from 2"—3" in height. Seedlings raised from September sowing however should be pricked out in March when about 2" in height.

10. *Method of transplanting.*—Seedlings are transplanted in *thalis* 6' x 6' very carefully with balls of earth. Seedlings from seeds sown immediately after collection are planted out in their first July-August when about 2"—3" high, while those from September sowing are planted out in the following June when about 1' in height. Winter transplanting after stripping the leaves of 9 months old seedlings when about 4" in height from seed sown immediately after collection, has given over 70 per cent. success and this method is recommended for filling up vacancies. The secret of successful transplanting of *birch* is the selection of plants of a suitable size, and the very careful attention to all rules of planting. Seedlings must be put out *immediately* after lifting from the nursery and must on no account be allowed to lie about before planting. It has been pointed out that the day on which planting takes place is of great importance. It must be cloudy, and the ground should not be too soggy and dripping wet, and again planting cannot be done before there has been sufficient rain. A happy medium between these two conditions appears to be the most suitable.
11. *Treatment after transplanting (weeding and cleaning).*—When small seedlings are put out, great care must be taken to see that the *thalis* are kept clean and that the young seedlings are not suppressed by weeds, as being light-demanding they would soon die out.

12. *Tending*.—After 4 years canopy is complete and little tending is required. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests*.—Is frost-hardy but cannot stand fire. Browsed by cattle and deer. Attacked by a defoliator.
14. *Rate of growth*.—Comparatively slow for the first two or three years but afterwards very fast growing. Average rate of growth in plantations at Takdah, Darjeeling Division, at an elevation of 5,500', is as follows:—1st year—1'—0"; 2nd year—3'—0"; 3rd year—4'—6"; 4th year—7'—2". The average girth of dominant stems in a 12-year old plantation at 4,000' elevation (Mungpoo) was 3'—2" and they are very tall.  
Sample Plot No. 3, Darjeeling Division, at Sambong at an elevation of 3,700', gave an average diameter of 17.6" height of 144', and a volume of 8,817 c.ft. per acre down to 8" diameter in 42 years. Stem analysis of a tree at Sim, Takdah Range, Darjeeling Division, at an elevation of 3,000', gave a girth of 6'—7", height of 140', and a volume of 150 c.ft. down to 8" diameter in 64 years.
15. *General remarks*.—A valuable tree that has been very well reported on as an excellent utility timber. Probably gives the biggest outturn per acre of any species put out in Bengal. In the past great difficulty was experienced with the transplanting of this species and intensive experiments have since been carried out as to the best size and time of transplanting. The usual method was to keep seedlings in the nursery until the second rains and put out when about 2' high. Plants so tall were found to be very delicate, and with the very greatest care not more than 20 to 40 per cent. survivals were recorded. The results of experiments with different sizes and time of planting are as follows:—

| Age.          | Average height. | Time of planting.      | Results.  |
|---------------|-----------------|------------------------|-----------|
|               |                 |                        | Per cent. |
| 4-5 months .. | 2½"             | Beginning of August .. | 75        |
| 9 .. ..       | 4"              | January ..             | 70        |
| 10 .. ..      | 1'-0"           | June ..                | 70        |
| 15 .. ..      | 2'-0"           | June ..                | 25        |
| 21 .. ..      | 2'-9"           | January ..             | 8         |

This shows that both seedlings raised from seeds sown immediately after collection and put out in August of the same year when 2"—3" high, and those raised from seeds stored and sown in September and put out the following June when 1' high, have given the best results. The former method is the one that has been so successful in raising the every excellent *birch* plantations at Mongpoo, and is the method that is at present recommended. Heavy manuring of nursery beds must be done in order to get seedlings large enough to put out in the first July-August.

Winter transplants of seedlings 9 months old when 4" high from seeds sown immediately after collection have also given good results and this method is recommended for filling up vacancies in the first year.

These methods detailed above are the only ones recommended for raising this species and it is a waste of time and money to use bigger plants as was tried in the past.

This species must be put out on a much larger scale than has been done in the past and should as far as possible replace *utis* as explained under *Alnus nepalensis*, paragraph 15. Should not be put out pure but in alternate lines with slower growing shade-bearers.

***Bischofia javanica* (Kainjal—Nep., Uriam—Beng.).**

1. *Locality*.—Plains up to 3,000' specially on silt near rivers in the plains; also in the forests of the three Chittagong Divisions.
2. *Seed time*.—December-January.
3. *Weight of seed*.—27 lbs. of fruits give 1 lb. of clean seeds. 2,650 seeds to the ounce.
4. *Method of collection of seed*.—The fruits turn red when ripe and are then collected from the tree.
5. *Method of treating seed*.—Keep the fruits for a few days in the shade to rot, wash off the pulp and dry the seeds.
6. *Method of seed storage*.—Seeds do not keep well and should be sown as soon as possible.
7. *Sowing (method and quantity of seed)*.—Sowing should be done thinly in shaded beds in the nursery either by broadcasting or in drills 3" apart as soon after collection as possible. 1 lb. of seed per *kamra* will suffice. No manure or leaf mould is required for the seed beds. Beds are sometimes covered with thatch grass to hasten germination.

8. *Germination (time, percentage, etc.).*—Germination good 90 per cent. complete within 14 to 20 days.
9. *Treatment in nursery.*—Watering is done almost daily before germination and continued for a few weeks afterwards. If sown thinly no pricking out is necessary. Shades should be removed a short time before transplanting.
10. *Method of transplanting.*—Transplanting can be done entire in *thalis* 6' x 6' with or without a handful of earth round the roots any time during the rains. Root and shoot cuttings with plants too big to transplant have given cent. per cent. success.
11. *Treatment after transplanting (weeding and cleaning).*—As this species is usually put out in damp and low-lying areas where climbers are usually bad, careful attention should be paid to climber-pulling until the canopy is closed.
12. *Tending.*—Thinning is done after 5 growing seasons. It should be light, as if opened out too much this species tends to fork and becomes branchy. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests.*—Young plants are browsed and the bark of the older plants are damaged by deer rubbing and gnawing. Mole crickets damage seedlings in the nursery.
14. *Rate of growth.*—Grows moderately fast in suitable localities, and appears to grow throughout the cold weather. Average rate of growth in plantations at Dalgaon in the Jalpaiguri Division is as follows:—1st year—2'; 2nd year—6'; 3rd year—9'; 4th year—15'; 5th year—22'. Sample Plot No. 21 of Buxa Division at Godamdabri at plains level gave an average diameter of 6.4" and average height of 52' in 12 years.
15. *General remarks.*—Very useful species to plant up low-lying areas in plantations. Should not be used to fill up single vacancies in *sal* lines as when grown singly it tends to branch and in a short time will overtop any plants near it. Is often used as a subsidiary species in mixtures with light canopied species such as *pitali* in order to keep down weeds and climbers. It is removed as soon as it interferes with the principal species.

**Bombax malabaricum** (Simal—Hind., Tula—Beng.).

1. *Locality*.—In Northern Bengal from plains where it prefers a light soil near big rivers up to 3,000', also in Southern Bengal. Regenerates itself in open spaces where soil is suitable.
2. *Seed time*.—March-April.
3. *Weight of seed*.—3 lbs. of fruits give 3 ounces of clean seeds. 780 seeds to the ounce.
4. *Method of collection of seed*.—Fruit is best collected from the tree. To avoid the collection of unripe seeds, fruits should not be collected before they start to open.
5. *Method of treating seed*.—Pods are put in the sun to open, sheltered from wind to prevent the seeds being blown away.
6. *Method of seed storage*.—Seeds have been kept for a year in gunny bags in a dry cool ventilated shed.
7. *Sowing (method and quantity of seed)*.—Sow direct in *thali* 9'×9' or 12'×12', several seeds to a *thali*. Not often sown in nurseries, as it is difficult to transplant. Might be sown broadcast with a mixture of other seeds in burnt fuel coupes. If sown in the nursery is dibbled in drills 3" apart.
8. *Germination (time, percentage, etc.)*.—About 40 per cent.
9. *Treatment in nursery*.—
10. *Method of transplanting*.—At Rajabhatkhawa it has been found that seedlings left through one rains in the nursery can be transplanted successfully when leafless in January and early February, after trimming the tap roots. Transplanting at the beginning of 2nd rains was not successful, the growth being checked at the beginning of the growing season. In Assam it is planted 26'×26', but in Bengal 9'×9' or 12'×12'. It is reported that branch cuttings take fairly easily and root sections from the tap root after preparing stumps also grow quite well. The success of stump planting depends entirely on the length of the root, 6" root giving 38 per cent. survivals and 24" 90 per cent. Big stumps appear best, probably 1" in diameter at the collar, perhaps greater.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—A quick grower and requires little tending after the first year.



13. *Diseases and pests.*—Pure plantations have been very badly attacked by the bud worm *Tonica niviiferana* Wlk. (*Ecophoridae*) which destroys the whorls of young shoots and often kills the plant outright.
14. *Rate of growth.*—At Lakhimpur (Assam) 18 months old plants were from 8' to 15' high, and in their 3rd year 30', this appears to be exceptional and the rate of growth in Bengal is undoubtedly slower.
15. *General remarks.*—It is difficult to know how to raise this tree successfully. If grown pure, from the size of the crown and method of branching, it would appear that the trees in the final crop would have to stand very widely spaced and so the resulting yield would be small. On the other hand it has been found very difficult to raise in a mixture with species of roughly the same rate of growth, owing to its rapid growth and horizontal method of branching. In a mixture of *gamar* and *toon*, it was found necessary to remove all *simal* in the 5th year as it was damaging the other species owing to the lateral growth of its branches. At Sukna, a mixture of *simal* and *gamar* resulted in complete suppression of the latter. For these reasons this species has practically ceased to be put out in Bengal. A mixture of alternate lines or alternate groups of lines with slower growing shade-bearers should prove the best solution.

***Bucklandia populnea* (Pipli—Nep.).**

1. *Locality.*—A strong shade-bearer in mixed forests between 3,000' to 7,000'. Best round about 3,000' to 4,500'. Natural reproduction is good on broken ground such as landslips. Is very susceptible to differences in elevation, aspect and rainfall. Best on aspects not exposed to cold driving winds. Does not usually do well on the outer hills above 4,500', but on the other hand does well at Batasi (7,000'), probably on account of lower rainfall. Suffers severely from frost, and at Tung (5,000') an aspect exposed to cold driving winds it is mixed with *utis* in alternate lines 6' apart and even under the shade of the *utis* its leaders have been frost-bitten year by year and it never seems to get away. In view of the above, more care should be taken in the selection of suitable localities for this species than has been done in the past.

2. *Seed time*.—Seeds all the year round. Large quantities of seeds are available in December-January.
3. *Weight of seed*.—1 lb. of fruit gives 2 ounces of clean seeds. 7,600 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the trees by lopping branches.
5. *Method of treating seed*.—Fruits are dried in the sun and seeds are extracted by gentle thrashing and winnowing.
6. *Method of seed storage*.—Can be stored for a year by spreading seeds on mats in a dry ventilated room.
7. *Sowing (method and quantity of seed)*.—Seeds are sown broadcast in well manured shaded beds in March. 1 lb. of seed per *kamra* will suffice. Brushwood and thatch grass is often spread over the beds to hasten germination.
8. *Germination (time, percentage, etc.)*.—Germination good up to 75 per cent. Is complete in 2 to 4 weeks. The higher the elevation the longer it takes to germinate.
9. *Treatment in nursery*.—Seed beds should be shaded. Seeds are sown in March and pricked out in June-July. Shades are not necessary at lower elevations in pricking out beds except during the hail season, but at high elevation shades should be used to prevent frost damage during the cold weather. At high elevations may be kept for 2 years in the nursery.
10. *Method of transplanting*.—Transplanted 6' x 6' in *thalis* entire with or without a handful of earth round the roots not later than the middle of the following June. It has been found that if all leaves are stripped except the leading shoot, winter planting of 2 rains old seedlings can be done with success, but should not be put out where frost is liable to occur. Natural seedlings 2"—3" in height have been transplanted into plantations with success. It is seldom put out pure except at lower elevations. At higher elevations the practice now is to mix *pipli* with *utis* or *birch* in alternate lines 6' apart, these being quick growers help to protect *pipli* from frost damage. At Sim, Darjeeling Division, 4,000' elevation has been mixed in alternate lines with *panisaj* and looks very promising as a two-storied mixture.

11. *Treatment after transplanting (weeding and cleaning).*  
—Slow grower, so fairly frequent cleanings are necessary during the first 2 or 3 years.
12. *Tending.*—When 3 to 5 years old should be pruned in order to select one straight stem, and about the 10th year the only operation necessary is the removal of double stems that may be left and pruning of trees forked near the ground. First thinning must be delayed and is not usually necessary before the 15th year. This species must be grown close, as even if a slight break is made in the canopy the young trees will immediately fork. This tendency makes thinning very difficult all through its life, and therefore thinning should be light and frequent. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests.*—Grazed by deer and cattle. Suffers from attacks by a leaf-roller (*Psyllidæ*) and is subject to insect pests generally. Young plants are sometimes killed by an insect girdling the stem below the ground. A species of Lepidoptera (*Zeuzera*) has been found boring small holes about the size, of a match in the stem of two-year old seedlings. Is attacked by a shoot-borer *Rhynchites bucklandiæ* and by the defoliator *Miresa thermistis*.
14. *Rate of growth.*—Growth is slow at first and fairly fast later, especially at lower elevations. At Mahaldaram, Kurseong Division, at an elevation of 6,300' the average growth in plantations is as follows:—1st year—9"; 2nd year—1'—9"; 3rd year—3'—1"; 4th year—4'—7"; 5th year—5'—11".  
Sample Plot No. 15 of Kalimpong Division at Algarah at an elevation of 6,000' gave an average diameter of 3.6" and height of 27' in 9 years. Sample Plot No. 7 in Darjeeling Division at Rangirum at an elevation of 5,300' gave an average diameter of 14.4", height of 100', and volume of 6,202 c. ft. per acre down to 8" diameter in 53 years. Stem analysis of a tree at Mahaldaram 2, Kurseong Division, at an elevation of 6,000' gave a girth of 5'—2", height of 75', and volume of 47.4 c. ft. down to 8" diameter in 42 years.
15. *General remarks.*—

***Calophyllum polyanthum* (Kamdeb—Chitg.).**

1. *Locality*.—Evergreen forests of the three Chittagong Divisions, chiefly found in the Kasalong Range of the Chittagong Hill Tracts and the mixed evergreen forests of the Garjania Range (Cox's Bazar). Prefers cooler north and east aspects; soil clayey loam to sandy loam, moist. Elevation up to 500'. Often gives profuse regeneration below mother trees, but the seedlings do not persist long.
2. *Seed time*.—Middle of April to middle of May.
3. *Weight of seed*.—60 clean fresh seeds to the ounce. 116 seeds to the ounce when dried.
4. *Method of collection of seed*.—Collected from trees. Difficult to collect, as mother trees are mostly very tall and seeds are too small to collect from the ground. Mature seeds are collected by lopping branches of trees, seeds being plucked by hand.
5. *Method of treating seed*.—Nothing particular except spreading out and drying in shade after seeds have been collected.
6. *Method of seed storage*.—Seeds do not keep well and it is essential to sow as soon after collection as possible.
7. *Sowing (method and quantity of seed)*.—Seeds are small and in the nursery are either sown broadcast or in drilled lines in beds which have been mixed with a certain amount of leaf mould. Seeds should be covered with a fine layer of earth over them. Two pounds of seeds per *kamra* will suffice. Mainimukh reports that shades are not necessary, but experiments in the Silvicultural Nursery and Garden at Hazarikhil show that germination in the shaded beds is slightly better than in unshaded. Direct sowing in plantations has not yet been tried.
8. *Germination (time, percentage, etc.)*.—Germination starts in 2 weeks and is complete in 2 months. At Mainimukh where seeds were sown soon after collection germination gave up to 80 per cent. within 5 weeks, after which no further germination was noticed. At Hazarikhil seeds from the same source sown about 3 to 4 weeks after collection have only given up to 25 per cent.

9. *Treatment in nursery.*—Careful weeding should be done and slight watering with a fine rose when necessary. Soil should be loosened round the young seedlings at the time of germination as they appear to have difficulty in pushing up through the soil. If seeds are sown early, plants can be put out in July of the same year and no pricking out is necessary.
10. *Method of transplanting.*—Very successful on a small scale in the Silvicultural Garden at Hazarikhil, plants were put out at the end of the first July when about 4" in height with a handful of earth round the roots. Mainimukh did some transplanting in 1928 and 1929 with balls of earth when the plants were 5" to 6" high in July of the same year. Percentage of survivals was 85 in 1928 and 60 in 1929. Stump planting has not yet been tried.
11. *Treatment after transplanting (weeding and cleaning).*—Weeding throughout the rains as required.
12. *Tending.*—Weeding should be done during the rains when necessary, and not during the cold or hot weather. The soil should not be exposed unduly as weeds help to shade the soil during the hot weather and so prevent casualties due to drought. Climber pulling should however be done when necessary.
13. *Diseases and pests.*—None yet noticed.
14. *Rate of growth.*—One month— $3\frac{1}{2}$ "; 1' in 1 year; 3' in 2 years.
15. *General remarks.*—From observations in the high forest, this species does not seem to be fast-growing. It prefers a certain amount of shade and should therefore only be put out on the cooler north or east aspects and on the lower slopes of ridges. It is seldom found in pure patches to any extent and so would appear best grown in a mixture. Has been tried for undersowing in *gamar* plantations in the Chittagong Hill Tracts and about 60 per cent. germinated. Since then majority of the plants have died, whether this is due to the shade of the *gamar* or not is not known. Has only been tried on a very small experimental scale up to the present. Should be tried in alternate line mixtures with fast growing light-demanders.

***Cedrela febrifuga* (Tuni—Nep.).**

1. *Locality*.—Middle and upper hill forests, 4,000' to 7,000'. Common in the Lopchu Block, Takdah Range, Darjeeling Division, and in the Dumsong and Labha forests of Pankhasari Range, Kalimpong Division. Gives good natural regeneration under suitable conditions.
2. *Seed time*.—January-February.
3. *Weight of seed*.—One pound of fruits give  $2\frac{1}{2}$  ounces of clean seeds. 3,600 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the trees by lopping branches. Fruits should be collected as soon as one or two fruits crack and fall from the tree.
5. *Method of treating seed*.—Fruits are spread out in the sun until they start to open, beaten by sticks to break up the fruits, and then seeds are separated by winnowing.
6. *Method of seed storage*.—Seeds are not stored as they should be sown immediately after collection.
7. *Sowing (method and quantity of seed)*.—Sown broadcast immediately after collection in shaded nursery beds. Seeds should be sown immediately after collection in order to get plants big enough to put out in the first rains when about 6" high, as this size is considered the most suitable for transplanting. 8 ounces of seeds per kamra will suffice.
8. *Germination (time, percentage, etc.)*.—Germination good, up to 65 per cent., starts in 2 weeks and is complete within 6 weeks.
9. *Treatment in nursery*.—The usual standard method of weeding and watering. Seedlings are pricked out into shaded nursery beds when they are big enough to handle. Shades should be removed some time before transplanting.
10. *Method of transplanting*.—Seedlings are transplanted 6' x 6' in *thalis* entire with a handful of earth round the roots. Larger seedlings of 6" and over are put out in July-August of the first rains, the remainder being left until the second rains when they are put out about 2' high. Cold-weather transplanting of 10 months and 21 months old seedlings after stripping leaves gave cent. per cent. success. Is an extremely hardy plant to handle.

11. *Treatment after transplanting (weeding and cleaning).—*Cleaning and weeding as usual.
12. *Tending.—*
13. *Diseases and pests.—*Browsed by game. Is attacked by the twig-borer (*Hypsipyla robusta*), but resulting damage is not harmful.
14. *Rate of growth.—*Comparatively fast. The average rate of growth in plantations at Takdah in Darjeeling Division at an elevation of 5,500' is as follows:—1st year—2'; 2nd year—4'—6"; 3rd year—7'. Stem analysis of a tree at Lopchu, Darjeeling Division, at an elevation of 4,500', gave a girth of 6'—4", height of 87', and a volume of 90 c. ft. down to 8" diameter in 52 years.
15. *General remarks.—*This species has a good local market and is extremely easy to regenerate. More of this species should be put out at elevations at which it grows. Should be a suitable substitute for *utis*.

*Cedrela microcarpa* (Tuni-Nep.).

1. *Locality.—*Foot-hills up to 4,000'. Common at Bamanpokhri in Kurseong Division and in the Teesta Valley. Regenerates itself well under suitable conditions.
2. *Seed time.—*March-April. Best time of collection is the middle part of April.
3. *Weight of seed.—*1 lb. of fruits give 2½ ounces of clean seeds. 560 fruits to the lb. 10,500 seeds to the ounce.
4. *Method of collection of seed.—*Fruits are collected from the trees by lopping branches. To avoid collection of unripe seed wait till the fruits turn yellow and one or two start to open.
5. *Method of treating seed.—*Fruits are spread out in the sun for 3 or 4 days until they start to open, beaten by sticks to break up the fruits, and then seeds are separated by winnowing.
6. *Method of seed storage.—*Seeds can be stored until ready for direct sowing in May.
7. *Sowing (method and quantity of seed).—*Seeds are usually sown in May direct in lines 6' apart or in *thalis* 6' x 6', line-sowing being preferred to sowing in *thalis*. Lines are hoed 1' wide and seeds are sown thickly broadcast over a width of 3' in the middle of the lines

and lightly covered with earth. Better results are obtained by sowing the seed without levelling the soil after hoeing, as this helps to prevent the seed being washed away. In line sowing the seed gets washed into little heaps by the rain and so germinates in clumps. Seedlings should then be pricked out and evenly spaced in the lines as soon as they are big enough to handle. Direct sowing should not be done on steep slopes as seeds will be washed away, and when planting up such areas *toon* should be raised in *kuchha* unshaded nurseries and planted out into the lines 1' to 2' apart as soon as the rains break. Is a comparatively good shade-bearer and should be suitable as a substitute for *Cedrela toona* for direct sowing when *bhadai paddy* is raised as a field crop. 50 lbs. of seeds are required per acre for line sowing, and 4 lbs. per acre for sowing in *thalis* 6' x 6'. In the nursery seeds are thinly broadcast in shaded beds. 2 ounces of seed per *kamra* will suffice.

8. *Germination (time, percentage, etc.)*.—Germination good, about 80 per cent. Commences in a week and is complete within 14 days.
9. *Treatment in nursery*.—Seeds should be sown thinly in shaded beds and no pricking out is necessary if plants are to be put out in the first rains. If plants are to be kept until the second rains pricking out should be done into shaded beds as soon as the plants are big enough to handle. Shades should be removed some time before transplanting.
10. *Method of transplanting*.—Transplanted entire with or without a handful of earth round the roots in the 1st or 2nd rains. Cold-weather transplanting with entire plants of the same year after plucking off all the leaves except the leading shoot is often done. Root and shoot cuttings with bigger plants give very successful results.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—Thinning of this species should be the same as that given for *Cedrela toona* and has been the subject of a separate note.
13. *Diseases and pests*.—Badly browsed by game. Should not be put out unless plantations can be fenced. Is badly damaged by the twig-borer (*Hyssipyla robusta*) and looks as if it will never recover, but eventually pulls through and after several years no sign of damage can be seen.



14. *Rate of growth*.—Fast. Rate of growth in plantations in the Tista Valley is as follows:—1st year—4'—2"; 2nd year—6'—0"; 3rd year—8'—6"; 4th year—10'—6"; 5th year—16'—6".  
Stem analysis of a tree at Riyang, Darjeeling Division, at an elevation of 800' gave a girth of 7'—4", height of 110', and a volume of 143 c.ft. down to 8" in diameter in 52 years.
15. *General remarks*.—This species is a comparatively heavy shade-bearer and should be a useful substitute for *chak-rase* in mixed line sowings with such species as *panisaj*, *gamar*, etc.

**Gedrela toona** (*Tuni*, *Tun*—Nep., *Surajbet*—Chitg.).

1. *Locality*.—Plains forests of Northern Bengal where it prefers a light soil in the neighbourhood of large rivers; also in the forests of the three Chittagong Divisions. Rather capricious as to site and should only be put out where it really does well. Often gives good natural regeneration.
2. *Seed time*.—Northern Bengal latter part of April, May, and first part of June. Southern Bengal mature seed is to be found from the beginning of March. Best time to collect is from middle to the end of March.
3. *Weight of seed*.—1 lb. of fruit gives 3 ounces of clean seeds. 10,000 seeds to the ounce.
4. *Method of collection of seed*.—Collected by lopping branches. To avoid collecting unripe seeds, wait until the fruits turn yellow and one or two start to open.
5. *Method of treating seed*.—The fruits are spread out for 3 or 4 days until they start to open, beaten with sticks to break up the fruits, and then the seeds are separated by winnowing.
6. *Method of seed storage*.—Can be stored for one year if seeds are kept in a well-ventilated shed.
7. *Sowing (method and quantity of seed)*.—Seeds are usually sown in May direct in lines 6' apart or in *thalis* 6' × 6'; line sowing being preferred to sowing in *thalis*. 20 lbs. of seeds are required per acre for line sowings and 4 lbs. per acre for sowing in *thalis* 6' × 6'. Lines are hoed 1' wide and seeds are sown thickly broadcast over a width of 3" in the middle of the line and lightly covered with earth. Better results are obtained by sowing the

seed without levelling the soil after hoeing as this helps to prevent the seeds being washed away. With direct sowing even on level ground seeds are liable to be washed into little heaps during the rains and so germinate in clumps. As soon as the plants are big enough to handle from 3' to 4' in height they should be pricked out and evenly distributed in lines. Direct sowing should not be done on ground that is undulating otherwise the seeds are liable to be washed away and seedlings have to be collected from some distance and pricked back into the lines again. Experience has shown that when putting out such areas it is cheaper to make *kuchha* unshaded nurseries maintained by the villagers and plant out the seedlings in July of the first rains about 1'—2' apart in the lines. Again, does not appear to germinate when sown direct with *bhadai* paddy as a field crop. When *bhadai* paddy is used, *toon* should be transplanted from *kuchha* unshaded nurseries as mentioned above. Millet in the Kalimpong foot-hills also retards the rate of growth of *toon*, and care should be taken to see that it is sown some feet away from the lines of *toon* and that it is kept pressed back from the lines during the rains. Seeds when sown in the nursery require 2 ounces per *kamra* and are sown in shaded beds. A thin layer of thatch grass is sometimes spread over the seed beds to hasten germination.

8. *Germination (time, percentage, etc.).*—Germination fair, 40 to 60 per cent., complete from 7 to 14 days.
9. *Treatment in nursery.*—Seeds should be sown thinly in shaded beds and no pricking out is necessary if plants are to be put out in the first rains. If plants are to be kept until the second rains pricking out should be done into shaded beds as soon as the plants are big enough to handle. Seed and pricking out beds are apt. to be destroyed by ants. Shades should be removed sometime before transplanting.
10. *Method of transplanting.*—Transplanting entire with or without a handful of earth round the roots is done in the first or second rains. Cold weather transplanting with entire plants of the same year after plucking off all the leaves except the leading shoot is often done. Root and shoot cuttings with bigger plants give very successful results.

11. *Treatment after transplanting (weeding and cleaning).—**Boga-medeloa* sown between the lines at the same time as the *toon* has been tried in the Chittagong district, the idea being to keep down *assamlota* (*Eupatorium odoratum*). From observations made it would appear that the *boga-medeloa* suppresses the *toon*, its growth being extremely poor as compared with that in the open.
12. *Tending.*—Thinning in well-grown plantations is required in the 4th or 5th year after formation, and thereafter every 5 years. As this species tends to branch when opened out, the first thinning should be comparatively light. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests.*—Badly browsed by game and should not be put out unless plantations can be fenced. Is badly damaged by the twig-borer (*Hypsipyla robusta*) and often looks as if it will never recover, but eventually pulls through and after several years no sign of damage can be seen. At Bhomariaghona, Cox's Bazar Division, two-year old seedlings had been bitten off at the collar and at least 60 per cent. of the plants had been affected. Young saplings in the Buxa and Jalpaiguri Divisions have been killed off by the parasite *Loranthus scurrulla* Linn.
14. *Rate of growth.*—Fast. At Rehti, Jalpaiguri Division, at plains level the average rate of growth in plantations is as follows:—1st year—1'—3"; 2nd year—14'—1"; 3rd year—17'—2"; 4th year—20'—4"; 5th year—30'. Sample Plot No. 8 of Jalpaiguri Division at Madarihāt at plains level gave an average diameter of 9.1" and average height of 70' in 15 years. Stem analysis of a tree at Riyang, Darjeeling Division, at an elevation 800' gave a girth of 7'—2", height of 126', and a volume of 181 c.ft. down to 8" in diameter in 67 years.
15. *General remarks.*—This species has been out of favour owing to the attacks of the shoot-borer. Observations now show that after about the 6th or 7th year it recovers and eventually no sign of the damage can be seen. Being one of the few miscellaneous species always in demand it should therefore be put out more than has been done in the past. Can push through any jungle. Is a moderate shade-bearer. It has been suggested as a substitute for *chikrase* in mixed line sowings with *panisaj*. It is nowhere near such a good shade-bearer as *Cedrela microcarpa* and for this reason the latter should be preferred for mixed line sowings.

**Chukrasia tabularis** (*Halloñre-tun*—Nep., *Chikrase*—Beng.).

1. *Locality*.—Well-drained soil in the plains and up to 3,000'. Also in the forests of the three Chittagong Divisions.
2. *Seed time*.—January-February.
3. *Weight of seed*.—8 lbs. of fruits give 1 lb. of clean seed. 2,050 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the tree.
5. *Method of treating seed*.—Fruits are then dried in the sun for 2 or 3 days and seeds are separated by gentle thrashing, care being taken to protect them from being blown away by wind. Seeds should be dried in the sun for a few days before storing.
6. *Method of seed storage*.—Seeds can be stored in bags in the seed-shed until May.
7. *Sowing (method and quantity of seed)*.—Usually sown direct in lines 6' apart and sometimes in *thalis* 6' x 6' in May. 60 lbs. of seeds are required per acre for sowing in lines 6' apart. Lines are hoed 1' wide and seeds are sown thickly broadcast over a width of 3" in the middle of the line and lightly covered with earth. Better results are obtained by sowing the seed without levelling the soil after hoeing as this helps to prevent the seed being washed away. When sown direct in lines seeds often get washed into little heaps by rain and so germinate in clumps. Seedlings should then be pricked out and evenly spaced in the lines as soon as they are big enough to handle. Overcrowding in the lines leads to patches of seedlings dying off. Sown also as a mixture with seeds of *panisaj* and *mandane* at the rate of 1 part of *chikrase* to 15 parts of *panisaj*, and with equal parts of *mandane*, the idea being that as *panisaj* and *mandane* give little shade and grow very quickly, the slightly slower growing and more tolerant shade-bearing *chikrase* will come up as a second storey and help to cover the ground and keep down weeds and climbers. 2 bags of seed per acre is required for line sowing. In the nursery seed is sown in January or February under shade. 8 ounces of seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.)*.—Germinates in 7-10 days usually giving about 70 to 90 per cent. germination.

9. *Treatment in nursery*.—Germinates like mustard and cress and overcrowding in the seed beds may lead to patches of seedlings dying off. Is pricked out when 2 to 3 inches high in another shaded bed. Shades should be removed at least two weeks before transplanting.
10. *Method of transplanting*.—Seedlings are transplanted in June-July of the same year, with or without a handful of earth round the roots. Root and shoot cuttings of two year old plants too large to handle as transplants have given very good results. Cold-weather planting with all leaves plucked off except the leading shoot is also successful.
11. *Treatment after transplanting (weeding and cleaning)*.—Is a fairly fast-grower and little cleaning is required after the third year.
12. *Tending*.—First thinning is required in the 4th or 5th year and thereafter every 5 years. As this species tends to branch and fork, the first thinning should be comparatively light. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests*.—Badly browsed and barked by deer, so should not be put out in unfenced plantations. Damaged by a twig-borer (*Hypsipyla robusta*), but observations show that after about the 6th or 7th year it recovers and eventually no sign of the damage can be seen. Trees in S. P. No. 6 in 1920 plantation at Rajabhatkhawa, Buxa Division, have been killed by a fungus which has not yet been identified.
14. *Rate of growth*.—Fairly fast. At Central Mechi in Kurseong Division, at an elevation of 800', the average rate of growth in plantations is as follows:—1st year—3'—5"; 2nd year—8'—11"; 3rd year—18'—3"; 4th year—25'—6"; 5th year—29'. Sample Plot No. 8 of Buxa Division at Rajabhatkhawa at plains level gave an average diameter of 5.3", and height of 51' in 9 years. Stem analysis of a tree at Sukna, Kurseong Division, at an elevation of 400' gave a girth of 7'—4", a height of 90', and a volume of 121 c.ft. down to 8" in diameter in 42 years.
15. *General remarks*.—Makes an excellent veneer. It is suggested that more of this species should be put out in groups of lines mixtures.

***Cinnamomum cecidodaphne* (Malagiri—Nep. and Beng.).**

1. *Locality*.—Alongside perennial streams in the plains and up to 4,000'.
2. *Seed time*.—September-October.
3. *Weight of seed*.—4 lbs. of fruits give 1 lb. of clean seed. 1,200 clean fresh seeds to the lb.
4. *Method of collection of seed*.—Fruits, when they appear discoloured, are collected from the trees by lopping branches. Difficult to collect ripe seeds as parrots eat them as soon as they become ripe.
5. *Method of treating seed*.—The fruits are kept under shade for about a week to rot, seeds are washed to remove the outer coating and then dried under shade.
6. *Method of seed storage*.—Seeds cannot be stored and are sown immediately after treatment.
7. *Sowing (method and quantity of seed)*.—Test seeds in water, sound seeds will sink. Seeds are either dibbled 3" x 3" or sown in drills 4" apart in shaded nursery beds as soon after collection as possible. 5 lbs. of seed per *kamra* will suffice. Thatch grass is sometimes laid over the beds to hasten germination.
8. *Germination (time, percentage, etc.)*.—Germination is poor, irregular and slow, from 5 to 25 per cent. Takes more than 2 months to germinate.
9. *Treatment in nursery*.—Pricking out should be done into shaded beds as soon as the plants are big enough to handle. Shades should be removed a short time before transplanting.
10. *Method of transplanting*.—Seedlings should be transplanted with balls of earth in *thalis* 6' x 6' in the first rains. If *pucca* ball planting is carefully carried out there should be few if any casualties. Winter transplanting with seedlings in their first cold weather has given excellent results. Stump planting of the seedlings in their second rains has given 90 per cent. success.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—First thinning should be done in the 4th or 5th year and thereafter every 5 years. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests*.—Seeds are eaten by parrots. Plants are barked by deer. Many healthy trees have been found killed by a fungus in Sample Plot No. 6 in the 1920 plantation at Rajabhatkhawa, but it has not yet been identified.

14. *Rate of growth*.—Fast. At Sukna, Kurseong Division, at an elevation of 600', the average rate of growth in plantations is as follows:—1st year—3'; 2nd year—7'; 3rd year—13'; 4th year—18'—6"; 5th year—21'. Sample Plot No. 6 of Buxa Division at Rajabhatkhawa, at plains level, gave an average diameter of 5.3" and height of 51' in 8 years.
15. *General remarks*.—Very useful for planting up areas in *sal* plantations that are a little too damp for *sal*.

***Cinnamomum glanduliferum* (Malagiri or Kawla—Nep.).**

1. *Locality*.—Middle hill forests up to 7,500'. Common round Ramam in Darjeeling Division. Regenerates itself naturally under mother tress.
2. *Seed time*.—September-October. Best time to collect is October. Good seed years are irregular.
3. *Weight of seed*.—148 clean seeds to the ounce. 2 lbs. of fruits give 8 ounces of clean seeds.
4. *Method of collection of seed*.—Fruits are collected from the trees by lopping branches. Fruits turn red as an indication of ripeness. Difficult to collect ripe fruits as birds eat them as soon as they start to ripen.
5. *Method of treating seed*.—Fruits are spread in the sun to ripen off. Seeds are then washed in water to remove the pulp and dried in the sun for a week.
6. *Method of seed storage*.—Stored in boxes or gunny bags until February. Should be spread out in the sun occasionally to dry.
7. *Sowing (method and quantity of seed)*.—Seeds are sown broadcast in the nursery under shade in February.
8. *Germination (time, percentage, etc.)*.—Germination good, 80 per cent. Commences in 6 weeks.
9. *Treatment in nursery*.—Standard method of weeding and watering. Manuring has a beneficial effect. Seeds are liable to be damaged by rats and it is advisable to fence the beds with bamboo mats 2' high and 4" under ground both sides of which have been painted with coal tar. Seedlings should be pricked out 3" × 3" or 4" × 4" into shaded beds as soon as they are big enough to handle. Shades should be removed before transplanting.

10. *Method of transplanting*.—Transplanted 6' × 6' entire with a handful of earth round the roots in the second rains when about 1'–8" in height. Winter transplanting in the first cold-weather is successful. Seedlings up to 2' high have been transplanted from the natural forest with success.
11. *Treatment after transplanting (weeding and cleaning)*.—Usual cleaning and weeding.
12. *Tending*.—
13. *Diseases and pests*.—Nothing noticed.
14. *Rate of growth*.—Comparatively slow. 3'±–8" in 4 years.
15. *General remarks*.—

***Cryptomeria japonica* (Dhupi—Nep.).**

1. *Locality*.—An exotic which does well from 4,000' to 7,000', best 5,000' to 6,000'. Has given profuse natural regeneration at Sureil 5,500'. The essential conditions for successful natural regeneration are a light ground cover, humus should not be too deep, and the canopy so opened as to permit of alternate light and shade.
2. *Seed time*.—End of October, November and December.
3. *Weight of seed*.—13 lbs. of cones give 1 lb. of clean seed. 750 cones to the lb. 9,200 seeds per ounce.
4. *Method of collection of seed*.—Cones are collected from the trees by lopping branches. Cones turn black when ripe.
5. *Method of treating seeds*.—The cones are put out in the sun to dry and the seeds are extracted by gentle thrashing.
6. *Method of seed storage*.—Seeds are dried in the sun for a few days and can be stored in a well-ventilated place.
7. *Sowing (method and quantity of seed)*.—Seeds are sown broadcast mixed with ash, fine earth or leaf mould, in shaded beds in February. One lb. of seeds per *kamra* will suffice. The seed beds are often covered with brushwood to hasten germination.
8. *Germination (time, percentage, etc.)*.—A good germinator up to 80 per cent. Is complete within 3 to 4 weeks



9. *Treatment in nursery.*—Watering is done daily in the nursery bed but less frequently in the pricking out beds. This species is a slow-grower in the nursery and the seedlings are sometimes kept one year but more frequently 2 years in the nursery. Pricking out is usually done 3"×3" or 4"×4" into shaded beds in June of the first year, but if the plants are to be kept in the nursery longer than 2 years it is advisable to prick them out 6"×6". Shades should be removed from pricking out beds after about 3 months. Plants have been kept in the nursery for 3 years and put out when 4' high in the 1931 plantation, Lingding, Darjeeling Division, and gave 100 per cent. success. The Range Officer, Takdah, reports that the bigger the plants put out the less the number of casualties, and also there is a great saving in cleaning and weeding as the plants are above weed growth when put out.
10. *Method of transplanting.*—Transplanting is done in *thalis* 3'×3' or 4'×4' entire with or without a handful of earth round the roots in June of 2nd or 3rd year. Cold-weather planting in December and January with 2 rains old plants is also successful. Planting of cuttings taken from branches of varying sizes from 9" to 2'—6" high have been tried experimentally with varying success. It would appear that if the cuttings are carefully handled and are made just below a fork they will have a fair chance of success. In Japan such cuttings taken from the terminal parts of the side branches are first of all kept for 9 or 10 months in the nursery in order to form a good root system and then transplanted into plantations. This rather than planting direct in plantations is the correct method.
11. *Treatment after transplanting (weeding and cleaning).*—Too much cleaning of undergrowth in exposed positions is harmful. Has been planted as a mixture in alternate lines 6' apart with *utis* and *chanp*, but it is too early to draw any conclusions.
12. *Tending.*—The aim now is to grow *Cryptomeria japonica* with at least 6 rings to the inch. Thinning will therefore have to be delayed and would not appear necessary before about the 25th year.
13. *Diseases and pests.*—Seedlings are destroyed by insects in the nursery which eat them off at ground level. Sometimes damaged by frost. Young plants are often damaged by a species of *Cossidae*, the larva of which

bores a gallery through or round the stem, thus weakening it, which is then broken off by wind. Rats often kill young plants from 4 to 8 years by girdling them at ground level especially in Sonada and Dungdungia plantations, Darjeeling Division.

14. *Rate of growth*.—Slow until the third year. At Pubong, Darjeeling Division, at an elevation of 6,500', the average growth in plantations is as follows:—1st year—1'—3"; 2nd year—2'—5"; 3rd year—3'—11"; 4th year—6'—10"; 5th year—10'—1".  
Sample Plot No. 26 of Darjeeling Division at Lopchu at an elevation of 6,300' gave an average diameter of 5.8" and height of 34' in 15 years. Sample Plot No. 6 of Darjeeling Division at Rangirum at an elevation of 6,300' gave an average diameter of 18.4", height of 91', and volume of 12,554 c.ft. per acre down to 8" diameter in 37 years. Stem analysis of a tree at Rangirum, at an elevation of 6,200' gave a girth of 7'—2", height of 76', and timber volume of 105 c.ft. in 37 years.
15. *General remarks*.—*Cryptomeria japonica* must be grown pure and kept dense if good wood is to be produced. It is reported that wood exported from Japan has from 10 to 12 rings to the inch. There appears to be a great difference in the constituency of the sap-wood and heart-wood and the former is of little value. Much of the timber sold in the past has been from fast growing isolated trees with only 2 rings or less to the inch and this has made the wood unpopular in the district. An unthinned *Cryptomeria* plantation at an elevation of 6,200', planted 6' × 4', gave only 4½ rings to the inch at the age of 16 years, the centre rings being still wider. This indicates closer planting, either 3' × 3' or 4' × 4', and thinnings must not be carried out until the required 6 rings per inch have been obtained. In Japan the best quality timber is obtained from plants spaced 4' × 3' and the first thinning is carried out about the 15th year. Rates of growth in Bengal probably differ from that in Japan and so experiments have been laid out with different spacings in order to study the rates of growth and expenditure to be incurred on formation, future cleanings and thinnings. If owing to closer planting the expenditure rises beyond permissible limits alternative methods of obtaining slow growth must be studied. One suggestion is that it should not be put out under 6,500 where the rate of growth will naturally be slower and so very close planting would not be so necessary.

**Cupressus funebris.**

1. *Locality*.—An exotic. A few trees of this species have been put out in the past at Dowhill (6,300') and also at Rangirum (6,200'). The trees in these two places are doing fairly well. Suitable for elevations about 6,000'.
2. *Seed time*.—Seeds ripen May-June and have been collected from the above mentioned trees. Seeds are at present received from the Forest Botanist, Dehra Dun, in May.
3. *Weight of seed*.—18 cones to the ounce. 12,600 clean seeds to the ounce.
4. *Method of collection of seed*.—Cones are collected in April from the trees by lopping the branches.
5. *Method of treating seeds*.—After collection the cones are dried in the sun and seed extracted.
6. *Method of seed storage*.—Seeds can be stored for several months provided they are kept in a dry place, but it is more advisable to sow directly after collection.
7. *Sowing (method and quantity of seed)*.—Seeds are sown broadcast thinly in the nursery immediately after receipt from Dehra Dun in May in shaded beds and watered daily. 8 ounces of seeds per kamra will suffice.
8. *Germination (time, percentage, etc.)*.—Germination commences in 3 weeks and is complete within a month and gives 30 per cent. success.
9. *Treatment in nursery*.—Seeds are sown thinly broadcast so no pricking out is done. The larger seedlings are put out in the second rains when about 9"—12" in height. the smaller seedlings being kept until the third rains and put out when about 1'—8" in height. Seedlings must not be put out less than 9" in height above ground as smaller seedlings suffer from the shock of transplanting and many die off. Shades should be taken off a fortnight before transplanting.
10. *Method of transplanting*.—Transplanted entire with a handful of earth round the roots in their second or third rains. Should be put out in *thalis* 4' x 4' in order to obtain good quality timber. If put out 6' x 6' it grows too fast and the quality of the timber will be poor.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—
13. *Diseases and pests*.—None noticed up to date.

14. *Rate of growth.*—Average rate of growth in plantations at Takdah in Darjeeling Division at an elevation of 5,500' is as follows:—1st year—1'—6"; 2nd year—2'—9"; 3rd year—3'—7". Stem analysis of a tree at Dowhill, Kurseong Division, at an elevation of 6,000' gave a girth of 4'—3", height of 87', and volume of 56 c.ft. down to 8" diameter, in 47 years.
15. *General remarks.*—Is not so fast growing and does not appear as hardy as *Cupressus torulosa*. The latter should always be put out in preference when plants are available.

#### ***Cupressus torulosa*.**

1. *Locality.*—An exotic, suitable for elevations around 6,000'. There is one large tree in Rangirum Forest bungalow compound which is doing well.
2. *Seed time.*—Seeds have been collected from the tree at Rangirum in May. It has been suggested that the best seed is obtainable from China Range, United Provinces, and should be indented for through the Silviculturist, United Provinces.
3. *Weight of seed.*—8,000 to the ounce.
4. *Method of collection of seed.*—Cones are collected from trees by lopping branches.
5. *Method of treating seeds.*—Cones are put out in the sun to dry and seeds are extracted by gentle thrashing.
6. *Method of seed storage.*—Seeds are dried in the sun for a few days and can be stored in a well ventilated dry place.
7. *Sowing (method and quantity of seed).*—Seeds are sown thinly broadcast in shaded nursery beds immediately on receipt in June and not stored. 8 ounces of seeds per kamra will suffice.
8. *Germination (time, percentage, etc.).*—Germination commences in 5 weeks and is complete within 3 months with 30—40 per cent. success.
9. *Treatment in the nursery.*—No special treatment except the standard method of weeding and watering. As the seeds are sown thinly broadcast pricking out is not done and not considered necessary. The larger seedlings are put out in the second rains when about 9" high, the smaller ones are left till the third rains when they are put out with an average height of 2'. Seedlings

should not be put out less than 9' in height above ground as smaller seedlings are found to suffer from the shock of transplanting and many die off. Shades should be taken off a fortnight before transplanting.

10. *Method of transplanting*.—Entire with a handful of earth round the roots. Should be put out in *thalis* 4' × 4' in order to obtain good quality timber. If put out 6' × 6' it grows too fast and the quality of the timber will be poor. Plants put out 6' × 6' at Mahaldram at an elevation of 6,500' gave only 3½ rings per inch which is far too quick to produce a good quality timber.
11. *Treatment after transplanting (weeding and cleaning)*.—The usual cleaning and weeding.
12. *Tending*.—It grows so fast that in the first and second years after transplanting plants are liable to be blown over by the wind. This should be looked out for and the earth round each stem should be pressed down with the feet and the plants straightened. As a protection it is advisable to grow this species for the first two years with *bhutta* as a field crop.
13. *Diseases and pests*.—None noticed up to date.
14. *Rate of growth*.—Much faster than *Cupressus funebris* and more so than *Cryptomeria japonica*. Average rate of growth in plantations in Takdah, Darjeeling Division, at an elevation of 5,500', is as follows:—1st year—2'; 2nd year—3'; 3rd year—5'—6'.  
An exceptional plant was found to be 8' high in 3 years. At Mahaldram, Kurseong Division, at an elevation of 6,700' six-year old well grown plants were found to average 1' girth and 20' in height.
15. *General remarks*.—This species grows faster than *Cryptomeria japonica*. It produces a good quality timber and what is more important gives an excellent fuel. This means that thinnings should be saleable, which is not possible with *Cryptomeria* as it gives such a poor fuel. This species should be put out on a larger scale and should make an excellent substitute for *Cryptomeria*.

#### ***Dalbergia latifolia* (Setisal—Nep.).**

1. *Locality*.—On well-drained land west of the Tista from the plains up to 2,000'. Prefers sandy soil and should not be put out on clayey soil.

2. *Seed time*.—Seeds from December to May. Best time to collect seed is in February-March. Good seed is obtainable through the Silviculturist, Madras.
3. *Weight of seed*.— $1\frac{1}{4}$  lbs. of pods give 1 lb. of clean seed. 500 pods to the ounce. 1,000 seeds to the ounce.
4. *Method of collection of seed*.—Pods are collected from the trees by lopping the branches. Care must be taken to collect ripe seeds. Seeds ripen on the tree over a long period and so unripe seed is often collected. Pods turn dark brown as an indication of ripeness.
5. *Method of treating seed*.—Pods are dried in the sun and it is not necessary to extract the seeds. In fact better results have been obtained by sowing the pods than with clean seeds.
6. *Method of seed storage*.—Pods are kept in bags until direct sowing is done in May.
7. *Sowing (method and quantity of seed)*.—Pods are broken up into small pieces, each piece containing one or two seeds, and sown direct in lines 6' apart in May. The results by this method have been very successful. In the nursery seeds are dibbled  $3'' \times 3''$  in shaded beds as soon after collection as possible. 24 lbs. of pods are required per acre, for direct sowing in lines, and 3 ounces of seeds per *kamra* in the nursery.
8. *Germination (time, percentage, etc.)*.—Germination starts in a week and is complete in 3 weeks with 40 per cent. success.
9. *Treatment in nursery*.—Standard method of weeding and watering. Pricking out is not necessary when raising transplants as they are put out in the same year. For root and shoot cuttings plants should be kept in the nursery until the second or third rains.
10. *Method of transplanting*.—Transplanting with balls of earth with plants in their first rains has given 90 per cent. success. Winter transplanting with balls of earth with plants in their first cold weather has given cent. per cent. success. Stump planting with 2-or 3-year old stumps has given excellent results  $0.5''$ — $0.6''$ , diameter at the collar gives the best results, and  $0.8''$  appears to be the limiting size of a useful stump. Transplanting or stump planting should be done  $4' \times 4'$  as the canopy takes sometime to close up and the species is liable to fork.

11. *Treatment after transplanting*.—It is suggested in the case of root and shoot cuttings that it is advisable to go round after the plants have begun to sprout and at the time of first weeding, and pluck off all except one shoot and place some mud over the cut shoots. This will prevent forking.
12. *Tending*.—Rate of growth is slow at first, especially with direct sowing and transplanting and so frequent cleanings will be necessary.
13. *Diseases and pests*.—None noticed.
14. *Rate of growth*.—Slow growth at first. At Sukna, Kurseong Division, at an elevation of 500', the average rate of growth from direct sowing is as follows:—1st year—1'—7"; 2nd year—2'—8"; 3rd year—6'—0".
15. *General remarks*.—This species can be easily regenerated by all methods and only time will show which is the cheapest. Growth from direct sowing and transplanting appears to be slow and many cleanings will be necessary. Stump planting from plants in their third rains gives a faster growth and it may pay to do stump planting and so save cost in cleanings. Would not appear to be a suitable species to grow pure as it gives a very light canopy, and besides which the canopy takes a long time to close up, and the danger from climbers and weeds is great for many years. In direct sowing this species may be put out in alternate line mixtures with fast growing light demanders. If put out as transplants or stumps may be mixed with such species as *toon* or *chikrase* in alternate *thalis*.

***Dalbergia sissoo* (Sissu—Beng.).**

1. *Locality*.—Found naturally in old river beds in the plains where it gives profuse natural regeneration. Prefers sandy soil and should not be put out on heavy soils.
2. *Seed time*.—December-mid-February.
3. *Weight of seed*.—500 pods to the ounce. 1,500 seeds to the ounce.  $1\frac{1}{2}$  lb. of pods give 1 lb. of clean seeds.
4. *Method of collection of seed*.—Pods are collected from the trees by lopping branches. Pods turn black when ripe.
5. *Method of treating seed*.—The pods are dried in the sun after collection.

6. *Method of seed storage*.—Dried pods can be kept in gunny bags in a dry place until the rains. Care being taken to prevent damage by rats.
7. *Sowing (method and quantity of seed)*.—Before sowing pods are soaked in water for 2 days. Some Range Officers do not consider this necessary and the dried pods are broken into small pieces, 1 or 2 seeds in a piece and sown direct without any further treatment. Pods are sown in May thickly in lines 6' apart. 30 lbs. of pods are required per acre for direct sowing. Direct sowing is not recommended and stump planting is the only satisfactory method of raising *sissu*. In the nursery pods are dibbled 3"  $\times$  3" in unshaded beds in March. 1 lb. pods are required per *kamra*.
8. *Germination (time, percentage, etc.)*.—Germination within 7 to 15 days with 90 per cent. success.
9. *Treatment in nursery*.—Watering is done daily and constant weeding is required.
10. *Method of transplanting*.—Is transplanted 4'  $\times$  4' entire with balls of earth round the roots when the plants are small, it is advisable to puddle the roots in mud. Stump planting from 2-year old nursery plants, or from seedlings taken from the natural forest has been found to be the best method. Growth from stumps is much quicker than from transplants, so cost of weeding is less. Also plants from stumps are much sturdier than those from transplants, the latter always being very whippy. Some Range Officers prefer stumps from natural seedlings from the forest than from nursery plants as they say they do better.
11. *Treatment after transplanting (weeding and cleaning)*.—Regular cleaning and weeding are necessary after transplanting.
12. *Tending*.—Pruning of the side branches in the second year is advisable.
13. *Diseases and pests*.—Cock-chafers, and larva of a longicorn beetle have been noticed to damage the root system and often succeed in killing the plants. Young plants are browsed by deer and cattle.
14. *Rate of growth*.—Fast. The following is the average rate of growth of root and shoot cuttings at Rehti, Jalpaiguri Division.—1st year—3'—2"; 2nd year—15'; 3rd year—19'—6"; 4th year—23'—6"; 5th year—30'.



15. *General remarks.*—In plantations this species should not be put out pure as it gives a very light canopy and gets badly damaged by weeds and climbers. For this reason direct sowing is not recommended and the only satisfactory method is to stump it 4' x 4' in alternate *thalis* with such species as *toon*, *jarul*, *chikrase* in order to keep down weeds and climbers and so save cost in cleanings. Another satisfactory method is to stump *sissu* about 8' to 12' apart in dense line sowings of the above mentioned species.

This species is a transitory crop and in the natural forest is to be found confined solely to old river beds. It is an important question to decide whether we are justified in putting it out on soils which have become more stable and presumably unsuited to it. Although it grows fast at first, this is no indication that it will ever survive to maturity. Rather than put out plantations of this species it is suggested that more attention should be paid to the artificial planting up of newly-formed *chars* so as to aid natural regeneration and get a better stocking.

***Dichopsis polyantha* (Tali—Chitg.).**

1. *Locality.*—Evergreen forests of the three Chittagong Divisions, found mainly on cooler aspects on the lower slopes of the hills and on well-drained level ground. Soil sandy loam to clayey loam. Elevation up to about 500'. Is a comparatively heavy shade-bearer and reproduces itself abundantly especially in the evergreen forests of the Chittagong Hill Tracts, and has the power of persisting apparently indefinitely under a dense shade in a suppressed condition. Must never be raised in the open but always in conjunction with a light overhead cover.
2. *Seed time.*—April and May. Best time to collect is first week of May. Does not seed well every year, and so advantage should be taken of good seed years.
3. *Weight of seed.*—170 seeds to the lb. one month after collection.
4. *Method of collection of seed.*—From the ground under and around seed bearers.
5. *Method of treating seed.*—Seeds should be spread out and dried under shade. It is reported that soaking for 12 hours in water before sowing is an aid to germination.

6. *Method of seed storage*.—Seeds cannot be stored longer than 3 to 4 weeks; should preferably be sown within a few days after collection.
7. *Sowing (method and quantity of seed)*.—In the Chittagong Division *tali* has been raised very successfully by dense line sowings with *boga-medeloa*. The combination of dense line sowings and *boga-medeloa* forces the plants up to the light and the rate of growth is faster than when grown in *thalis*. Seeds should be sown in lines 6' apart as soon after collection as possible, 2-3 rows of seeds in each line, the seeds being about 8" apart in each row. It is essential that *boga-medeloa* should be put out in the same year as the *tali* in order to afford shade to the young seedlings during the first hot weather. With *taungya* crops the *boga-medeloa* is sown thickly broadcast at the time of the last cleaning of the *paddy* in August, and any blanks are re-sown in September after the *paddy* has been reaped. If sown later than August the *boga-medeloa* will not be tall enough to afford shade to the young *tali* during the first hot weather. In regular plantations *boga-medeloa* is sown in 1' wide lines in May of the first year. At Mainimukh in the Chittagong Hill Tracts Division, *tali* has been successfully raised in alternate lines 6' apart with *gamar*, *tali* being sown thickly as detailed above and the *gamar* being dibbled 6' apart in its line. This method will probably be adopted as the standard method of raising *tali* in the Chittagong Hill Tracts Division, but in the Chittagong Division, experience has shown that *gamar* does very badly and here sowing with *boga-medeloa* would be the most suitable method. The *boga-medeloa* and *gamar* besides affording shade to the young *tali* also helps to keep down *assamlota* and so saves money in weeding and cleaning. In the nursery seed should be dibbled 4" x 4" in shaded beds as soon after collection as possible, seeds being laid flat as they lie in the forest and covered as deep as the smallest diameter of the seed. 5 lbs. of seeds are required per *kamra*. It is reported that only large plump and well-filled seeds should be used, the smaller ones giving a very poor percentage of germination.
8. *Germination (time, percentage, etc.)*.—Germination commences at the end of 3 weeks and is complete in 2 months. From 40 to 80 per cent. germination has been obtained in the Experimental Nursery at Hazarikhil.

9. *Treatment in nursery*.—No special treatment is required except periodical weeding and slight watering. The latter to be done immediately before and after sowing. Manuring with leaf mould in particular will certainly help but is not an essential condition.
10. *Method of transplanting*.—Transplanted 6' x 6' entire with a handful of earth round the roots in August of the same year when 4" high with over 90 per cent. success. Stump planting has not been successful. *Boga-medeloa* should be sown in between the lines of *thalis* in the 1st year.
11. *Treatment after transplanting (weeding and cleaning)*.—Weeding should be done throughout the rains when necessary, but not during the cold and hot weather, as weeds help to shade the soil during the hot weather and so prevent casualties due to drought. Climber-pulling, however, should be done when necessary.
12. *Tending*.—It is not desirable to prune the *boga-medeloa* as the *tali* is a good shade bearer. If it gets too thick and is retarding the growth of *tali* all that is necessary is to thin some of the stems and cut the side-branches over-topping the *tali* lines. Also experience has shown that if *boga-medeloa* is pruned *assamlota* is liable to get a hold and kill it out. Any *boga-medeloa* found in the *tali* lines is pulled up.
13. *Diseases and pests*.—In wet areas a sort of leaf-disease appears which causes the leaves to narrow up. In the Silvicultural Garden and Nursery at Hazarikhil a few 2-year old plants were attacked and killed by a fungus pathogen. Specimens were sent to the Forest Botanist, Dehra Dun, who writes:—  
 "The surface of the root is covered with a fungus apparently of a saprophytic nature and at the collar region a white fungal growth was observed which was found to be a species of *Fusarium*."  
 Young plants are browsed by deer.
14. *Rate of growth*.—Slow. The average rate of growth in plantations at Hazarikhil, Chittagong Division, is as follows:—1st year—1'—9"; 2nd year—2'—11"; 3rd year—3'—10"; 4th year—6'—3".  
 Stem analysis of a tree at Mainimukh, Chittagong Hill Tracts Division, at an elevation of 500', gave a girth of 7'—1", height of 115', and a volume of 146 c.ft. down to 8" diameter in 119 years.

15. *General remarks*.—Direct sowing either with *boga-medeloa* or in alternate lines with fast-growing light demanders such as *gamar* is the only\* method recommended. In the plantation this species seems to prefer moist rather than dry conditions and is susceptible to drought and should, therefore, only be put out on the cooler north and east aspects and on the lower slopes of ridges. Has been found very successful for undersowing in *teak* and *gamar* plantations.

#### General notes on *gurjan* (*Dipterocarpus* spp.).

The results of observations, detailed experiments, and small scale Divisional plantations carried out during the past 8 years have now made it possible to draw up a satisfactory method of raising *Dipterocarpus turbinatus* both in *taungya* and *regular* plantations. Not much advance has been made with the artificial regeneration of the other species of *gurjan*, chiefly owing to the fact their seed besides ripening sometime before the break of the rains, is also much more severely attacked by insects than is the case with *D. turbinatus*. Detailed experiments are still being carried out by the Silvicultural Branch and it is hoped that some way will be found to circumvent these difficulties. The following gives a summary of conclusions arrived at up to date and also the present method of raising *gurjan* in plantations:—

1. For plantation purposes, owing to bad germination, *Dipterocarpus alatus* and *D. costatus* are impracticable. *D. pilosus* has given fair results, but *D. turbinatus* gives by far the best germination and is the easiest to raise, and should always be put out in preference to the others if seeds are available. The reason for this is that *D. turbinatus* does not take so long to ripen on the trees as the other species and so is not so liable to insect-attack. Also its seeds are ripe just at the break of the rains which is not the case with other species. The rate of growth of *D. turbinatus* is much quicker than the other *gurjans* in the younger stages, and this is a great point in its favour in plantations infested by *assam-lota* (*Eupatorium odoratum*).
2. From observations in the natural forest, it would appear that *D. costatus* is suited to the extreme top of ridges, *D. turbinatus* and *D. pilosus* to the slopes although actually not confined to them, and *D. alatus* to comparatively low ground in depressions at the bottom of ridges.
3. Our experiments and frequent observations in the three Chittagong Divisions have led us to certain conclusions. A shade or cover crop like *boga-medeloa* is essential for the purpose of

affording shade to the young *gurjan* during its first and second year, especially in the more exposed southern and western aspects, in order to prevent the young plants being dried up during the hot weather, and also to help to keep down *assamlota* until the *gurjan* is established. *Assamlota* is a very serious pest in young plantations and swamps everything it comes in contact with. The value of *boga-medeloa* as a preventor of weed growth cannot be questioned. It has also been recognised that although *gurjan* requires some sort of protection against being dried up by the sun during its first and second hot weather, at the same time it certainly grows better in the light and whenever light is let in, either from the side or from overhead, its growth is much more vigorous than under shade. Once established it can, however, persist under shade apparently indefinitely in a suppressed condition.

4. In *taungya* plantations the problem of combining field crops and *boga-medeloa* has been satisfactorily solved. It is not possible to sow *boga-medeloa* at the same time as the field crop as it will swamp the latter. The best time to sow the *boga-medeloa* is from the middle of July to the beginning of August at the same time as the last cleaning of the field crop. It must be sown thickly broadcast after scratching up the earth with a pointed stick, from 15 to 20 seers of seed per acre are required. Any blanks can be filled up by resowing in September when the *paddy* is reaped. Experiments have shown that if the sowing is left until after the reaping of the *paddy* in September, the *boga-medeloa* is too small to fulfil the object of shading the *gurjan* during the coming hot weather. Sowing is not possible in 1' wide lines as described below, for *regular* plantations as it is not possible to sow thick enough with a field crop on the ground, so must be thickly broadcast. Treatment of *boga-medeloa* in subsequent years should be the same as that mentioned under *regular* plantations below.

In *regular* plantations the problem is simpler as there is no field crops to consider and *boga-medeloa* can be put out the same time as the *gurjan*. The following is now the method of raising *gurjan* in *regular* plantations:—

*1st year: March*—Cleaning and burning. *March to May*—Hoeing done gradually all over the area. *May to June*—Sowing of *D. turbinatus* is usually started in the last week of May and continued up to the middle of June. The middle fall of the seed is considered the best. Seeds are sown in lines, 6' apart, 3' rows of seed to a line. Seed is *notched*, a process of making a hole with the point of a *dao* placing the seed in the hole and covering up the seed with earth, the wings being exposed.

*Boga-medeloa* is sown in the beginning of May. On the cooler north and east aspects and on lower slopes where its growth is good, it is sown thickly in lines 1' wide running centrally between the

*gurjan* lines, 10 to 15 seers of seed per acre are required. In exposed south and west aspects and on high ridges, where its growth is poor it is sown broadcast right up to the *gurjan* lines, with from 15 to 20 seers of seed per acre.

July to August—Cleaning done. Any *boga-medeloa* found in the *gurjan* lines are pulled up. Climber pulling instead of climber cutting is now carried out in all cleanings.

2nd year: May to June—Cleaning. *Boga-medeloa* is thinned wherever it is found thick. This includes lopping of side branches overtopping the *gurjan*.

3rd year: May—Cleanings. It was the practice on cooler north and east aspects and on lower slopes where the growth of *boga-medeloa* is good to prune it down to 6" below the height of *gurjan* plants. In some Ranges in order to give light to the young *gurjan* plants it is now considered preferable not to coppice back but to gradually thin out the stems of the *boga-medeloa* and at the same time to lop branches over topping the lines, because, it was found that by coppicing back, *assamlota* not infrequently got a hold and killed out the *boga-medeloa* before it could shoot up again. Whereas by gradually thinning it out *assamlota* was by no means so troublesome. In dry exposed south and west aspects and on higher ridges thinning of *boga-medeloa* is not usually necessary unless it is found overtopping *gurjan* as in such areas its growth is usually poor and it seldom overtops the *gurjan*.

4th year: May—Cleanings. *Boga-medeloa* is now becoming thin and is left to gradually die out.

5. From observations *gurjan* with the exception of *D. alatus* appears to be the most suitable species for putting out on higher and middle slopes of ridges in the Chittagong district provided it is put out with a shade crop. It does best on the less exposed north and east aspects and not so well, but certainly better than most other indigenous species, on the dry exposed south and west aspects. It also appears to be able to withstand being swamped by weeds such as *assamlota*, and after cleaning appears to be little the worse; broken or damaged leading shoots are seldom found as would be the case with other species. This species is seldom damaged by deer or elephants which enables it to be put out anywhere in unfenced plantations.

6. A certain amount of experimental nursery work with these four species has been carried out in the Silvicultural Nursery and Garden at Hazarikhil, Chittagong Division, in order to find out the best method of artificial regeneration and to study their germination per cent. and rate of growth, etc. Results of these observations have been noted for the different species under nursery work and transplanting. Contrary to all expectations it was found that with all the four species of *gurjan* transplanting of seedlings which

were sown in the same year, and stump-planting of one-year old nursery plants in the case of *D. turbinatus* and *D. pilosus*, were very successful on a small scale. However, direct sowing of these species is the only method recommended and nursery work is a waste of time and money, but as nursery work had actually been done for experimental purposes the results are noted in case they may be of interest.

***Dipterocarpus turbinatus* (Gurjan—Chitg.).**

1. *Locality*.—Found scattered in pure patches in the moister situations of the deciduous forests of Chittagong and Cox's Bazar Divisions. Nearly always pure on the lower levels of Khasmahal forests lately brought under (as well as adjoining) the reserves. Also very scattered in the mixed evergreen forests in the eastern part of Chittagong and in the Chittagong Hill Tracts. Found mainly though not confined on the middle slopes of hills on north-eastern or eastern aspects. Soil sandy loam.
2. *Seed time*.—Mature fruits are ready from May to middle of June. The best time to collect is from the fourth week of May till about the end of the first week of June. Seeds start germinating *in situ* from the first week of June. Good seed years are irregular but usually sufficient seed is available.
3. *Weight of seed*.—65 to 70 seeds with wings to the lb. weighed one day after collection. One 2-maund gunny bag of winged seed weighs about 40 lbs.
4. *Method of collection of seed*.—Seeds are collected from the ground under the mother trees. Before collecting, the ground should be cleaned and all seeds already fallen removed. Seeds should then be collected daily so as to avoid insect-attacked seeds.
5. *Method of treating seed*.—Seeds should be very carefully gone over before sowing and all insect-attacked seeds should be rejected. The seed is liable, though least so of all the *gurjans*, to the attack of *Alcides crassus* Pasc., *D. pilosus* being the worst attacked and *D. alatus* and *D. costatus* less so. The presence of the grub can be ascertained from a blob of gum on the seed. All light and damaged seed should be rejected and only plump and heavy seeds should be used. No other special treatment is required and if the seed is not immediately used may be spread in a well-ventilated shady place for a couple of days. \*

6. *Method of seed storage*.—Seeds ripen at the break of rains when the conditions of sowing are most suitable; so should be sown immediately after collection (end of May-June). Has been stored for 5 days under ideal conditions but after that deteriorates rapidly.
7. *Sowing (method and quantity of seed)*.—Seeds are usually sown direct in lines on cloudy days, and are best sown just after rain. Seeds are *notched*, a process which consists of making a hole in the ground with the point of a *dao*, placing the seed in the hole and just covering the seed with earth leaving the wings sticking out. This prevents the seeds being dried up by the sun if at the time of sowing there happens to be no rain, or if after sowing there should be a drought. Seeds are *notched* in hoed up lines 1'—6" wide, 6' apart, 2 or 3 rows of seeds in each line, the rows being 6" apart and the seeds 3" apart in the rows. The whole area is sown with one row first, second and third rows added in succession, exactly as done for *sal*. About 480 lbs. of seed (12 bags) is required per acre for sowing seed in 2 rows. Has also been sown in *thalis* 6' x 6' several seeds to a *thali*. Line sowing only is recommended as in *thalis* much growth is put into branches, and so height growth is poor, whereas in lines the plants get drawn up quickly and are much sooner out of danger from weeds. *Boga-medeloa* is sown between the lines. (Read paragraphs 3 and 4, General Notes on *gurjan*.) Has been raised fairly successfully in both alternate line 6' apart, and in alternate groups of lines mixtures, with *gamar* at Mainimukh, Chittagong Hill Tracts Division. The *gurjan* is sown thickly in lines as described above and the *gamar* dibbled 6' apart at stake in its line. It is not yet certain whether alternate lines or alternate groups of lines mixtures will be the best; although the former looks so promising a good deal of tending amongst the *gamar* has been necessary to let the *gurjan* develop and further experiments as to the best initial spacing of the *gamar* will be continued. Seeds have been sown experimentally in the nursery in shaded beds and dibbled 6" x 6". Seeds are laid on their edges, the soil covering being of the depth of the smallest diameter of the seed. About 4 lbs. of seeds per *kamra* are required.
8. *Germination (time, percentage, etc.)*.—Germination commences in one week and is complete within four weeks. Up to 85 per cent. germination has been reported from direct sowing. In the nursery 80 per cent. germination



has been recorded both in shaded and unshaded beds. Is by far the best germinator of all the *gurjans*.

9. *Treatment in nursery*.—No special treatment is required except the standard method of weeding and watering. Leaf mould manuring certainly helps but does not appear to be an essential condition.
10. *Method of transplanting*.—Has been transplanted experimentally in the Silvicultural Nursery and Garden at Hazarikhil entire with a handful of earth round the roots in July of the same year when about 6" high with complete success. Transplanting should be done immediately after raising from the bed and preferably on a wet day. Stump-planting of one-year old nursery plants on an experimental scale has also been very successful although condition and growth is not so good as by direct sowing or transplanting. Plants from direct sowing are on the average one foot higher than transplants at the end of first season.
11. *Treatment after transplanting (weeding and cleaning)* and 12. *Tending*.—Read paragraphs 3 and 4, General notes for *Dipterocarpus* spp. If it is not possible to use a shade crop, or for some reason the shade crop has failed, weeding and cleaning should only be done during the rains and not during the cold and hot weathers. The soil must not be unduly exposed and all weeds that are not actually interfering should be left to shade the plants. Climber pulling should be done when necessary.
13. *Diseases and pests*.—Liable to be dried up on exposed slopes during the first 2 or 3 years. Cannot stand fire. Seeds are attacked by *Alcides crassus* Pasc, and larva of several moths, such as *Blastobasis spormologa* Meyr, and *Laspeyresia pulverula* Meyr. The fruit body is presumably infected while in the young stage and the growth of the larva goes on with the growth of the fruit until the infected fruit is composed merely of the outer shell. This causes the fall of the seed before it is mature. A sure indication of insect attack is the presence of a drop of gum on the fruit body. This species is not so badly attacked as the other *gurjans*. Attacks by shoot-borers have been reported from Chittagong Division. Sometimes the leading shoots are browsed by deer but damage on a large scale has not been reported.
14. *Rate of growth*.—Growth moderate. At Hazarikhil, Chittagong Division, the average rate of growth in plantations is as follows:—1st year—1'—6"; 2nd year—3'—8"; 3rd year—6'—8"; 4th year—10'; 5th year—15'.

Sample Plot No. 3 of Chittagong Division at Goyal-mara, at plains level gave an average diameter of 4.7" and height of 47' in 11 years. Stem analysis of a tree at Dhroong New Reserve, Chittagong Division, at plains level, gave a girth of 8'—10", height of 132', and volume of 240 c.ft. down to 8" diameter in 120 years.

15. *General remarks*.—From experiments and observations in plantations of the three Chittagong Divisions it is to be recorded that this species is without doubt, the most suitable of all *gurjans* for plantations, as its seeds are not so badly attacked by insects and also they ripen just at the beginning of rains. Its germination per cent. is also much higher. The rate of growth is faster than other *gurjans*, which is a great advantage in plantations infested with *assamlota*. It appears to stand shade better than any of the other *gurjans*. Has been undersown with great success in *gamar* plantations in the Chittagong and Chittagong Hill Tracts Divisions. Its rate of growth when undersown in a 5-year old *gamar* plantation is as follows:—2nd year—3'; 3rd year—4'—6"; 4th year—6'; 5th year—8'; 6th year—10'—6"; 7th year—15'. Mixtures with *gamar* in the Chittagong Hill Tracts look very promising (see *Gmelina arborea*, paragraph 7). Great success has been obtained by "notching" the seed of this species under high shade in the natural forest and the use of this method in fuel coupes should be an excellent way of increasing the proportion of valuable species in the natural forest. The lower and middle storeys are cut as fuel, area burnt, and seeds *notched*, and the upper canopy which consists of the biggest and the best timber can be removed at any time that a market is found after the new crop of young *gurjan* has been established.

#### ***Dipterocarpus alatus* (Gurjan—Chitg.).**

1. *Locality*.—Found in the evergreen and also in the damper areas of mixed deciduous forests in the Chittagong district. Occurs sporadically in Patya, Garjania, Rezu and Teknaf Ranges, and more frequently in the latter where there is excellent natural regeneration near the sea-face at Mathabhanga. Found chiefly on silt along the bottoms of ridges, and in valleys in moist to swampy areas, and is rarely found far up on the slopes of ridges. Soil clayey loam to sandy loam, aspect cool and shaded, elevation up to 200'.

2. *Seed time*.—Fruits ripen from the end of March to the middle of May. Apparently ripe fruits are to be found as early as January, but these are invariably insect attacked and have probably fallen as a result of this. Experiments with collecting seed at different times have proved that April is the best month to collect seed.
3. *Weight of seed*.—57 to 60 good seeds with wings to the lb. within one week after collection.
4. *Method of collection of seed*.—As for *D. turbinatus*.
5. *Method of treating seed*.—As for *D. turbinatus*.
6. *Method of seed storage*.—Seeds should never be kept longer than a week and should be sown as soon after collection as possible, as besides losing their power of germination very quickly they are badly attacked by insects.
7. *Sowing (method and quantity of seed)*.—As for *D. turbinatus*, except that sowing in the nursery will require 5 lbs. of seed per *kamra*. Has not yet been tried in a mixture with *gamar*.
8. *Germination (time, percentage, etc)*.—Germination in the nursery commenced in 10 days and continued for one month and the best germination that has been obtained is 27 per cent. Germination was better in shaded than in unshaded beds. From direct sowing anything from 2 to 10 per cent. is reported.
9. *Treatment in nursery*.—As for *D. turbinatus*.
10. *Method of transplanting*.—Transplanting with 4" nursery stock in the second week of August gave almost cent. per cent. success on a small scale. Stump planting has so far been a failure.
11. *Treatment after transplanting (weeding and cleaning)*.—As for *D. turbinatus*.
12. *Tending*.—As for *D. turbinatus*.
13. *Diseases and pests*.—As for *D. turbinatus*, but no attack from shoot-borers has so far been reported.
14. *Rate of growth*.—Slow, 6" to 8" at the end of first year, 1'—6" to 2' at the end of the second year. Stem analysis of a tree at Lalutia, Chittagong Division, at plains level, gave a girth of 8'—2", height of 117', and a volume of 200 c.ft. down to 8" in diameter in 103 years.

15. *General remarks*.—Very little success has been obtained with this species both in plantations and in the Silvicultural Nursery and Garden. The seed ripens a considerable time before the break of the rains and so it is practically impossible to raise in plantations as at the time of sowing the ground is bone dry. All other species of *gurjan* require a well-drained ground such as slopes of ridges, but this species is more exacting as to soil requirements and prefers a clayey loam such as is found in depressions at the bottom of ridges where silt has been washed down. Under suitable conditions it regenerates itself naturally better than most *gurjans*, and some excellent pole crops are to be found in Teknaf Range, Cox's Bazar Division.

***Dipterocarpus costatus* (Gurjan—Chitg.).**

1. *Locality*.—Deciduous forests of Chittagong and Cox's Bazar Divisions, practically absent in the Chittagong Hill Tracts. This species occurs sporadically as well as in large pure patches from south of the Sangoo river up to the Naaf, mostly in the Jaldi, Garjanja, Rezu and upper parts of the Teknaf Ranges. Usually confined to shallow-soiled hill tops; soil coarse sand over sandy loam. Elevation up to 500' on all aspects.
2. *Seed time*.—Mature fruits are ready from the middle of April up to the third week of May, by which time seeds have all fallen on the ground. Best time for collection is in the beginning of May. Insect-attacked fruits are found as early as February.
3. *Weight of seed*.—Weighed on the day of collection 185 seeds to the lb. One week after collection selected seeds 230 to the lb.
4. *Method of collection of seed*.—As for *D. turbinatus*.
5. *Method of treating seed*.—As for *D. turbinatus*.
6. *Method of seed storage*.—As for *D. alatus*.
7. *Sowing (method and quantity of seed)*.—As for *D. turbinatus* except that sowing in the nursery will require 2 lbs. of seed per *kamra*. Has not yet been tried in an even aged mixture with *gamar*.
8. *Germination (time, percentage, etc.)*.—Germination commences from 7 to 10 days and is complete in 3 to 4 weeks. It is next to *D. turbinatus* and *D. pilosus* as regards germination per cent. and so far under nursery conditions, has not exceeded 25 per cent.

9. *Treatment in nursery*.—As for *D. turbinatus*.
10. *Method of transplanting*.—In some ranges natural seedlings from the forest have been transplanted experimentally into the plantation with a fair amount of success. Also transplanted from the nursery when 4" in height in August on a small scale with 73 per cent. success. Stump planting has so far been a failure.
11. *Treatment after transplanting (weeding and cleaning)*.—As for *D. turbinatus*.
12. *Tending*.—As for *D. turbinatus*.
13. *Diseases and pests*.—As for *D. turbinatus*, except that seeds of this species are more severely attacked. Shoot-borers have not so far been reported. Healthy poles of this species have been attacked by a stem-borer at Bhomariaghona, Machuakhali Block, Cox's Bazar Division.
14. *Rate of growth*.—Slow, about 6" to 8" in the 1st year; 1' to 1'—3" in the 2nd year; 1'—3" to 2' in the 3rd year; 2' to 3'—3" in the 4th year; 3'—3" to 5' in the 5th year. Stem analysis of a tree at Machuakhali, Garjania Range, Cox's Bazar Division, gave a girth of 6'—6", height of 98', and a volume of 93 c. ft. down to 8" in diameter in 82 years.
15. *General remarks*.—It is the hardest of the four *Dipterocarps* and once established requires the minimum amount of moisture, but on account of the seed being ripe sometime before the break of the rains, it is difficult to raise in plantations as at the time of sowing the ground is usually bone dry. Has been tried in the Chittagong Division for undersowing in *gamar* plantations, but does not do nearly as well as *D. turbinatus* and is not so tolerant of shade.

***Dipterocarpus pilosus* (Gurjan—Chitg.).**

1. *Locality*.—Found in the damper areas of the deciduous and also in the mixed evergreen forests of the three Chittagong Divisions, chiefly at Hazarikhil, Kasalong, Whykhong, and east of Garjania. Is not found over so large an area as *D. turbinatus*. Soil sandy loam and requires a moister and deeper soil than *D. turbinatus*; elevation up to 500'.

2. *Seed time*.—Mature fruits are ready from the first week of May to the end of the first week of June. Best time to collect is the middle of May. Seeds germinate *in situ* early in June.
3. *Weight of seed*.—90 fresh fruits with wings to the lb.
4. *Method of collection of seed*.—As for *D. turbinatus*.
5. *Method of treating seed*.—As for *D. turbinatus*.
6. *Method of seed storage*.—As for *D. turbinatus*.
7. *Sowing (method and quantity of seed)*.—As for *D. turbinatus*, except that sowing in the nursery will require 5 lbs. of seeds per *kamra*. Has not yet been tried in an even-aged mixture with *gamar*.
8. *Germination (time, percentage, etc.)*.—Germination commences in a week and is complete in 3 to 4 weeks. It is the next best germinator to *D. turbinatus*. 50 to 60 per cent. germination is reported from direct sowing, and 64 per cent. in shaded and 55 per cent. in unshaded beds in the nursery.
9. *Treatment in nursery*.—As for *D. turbinatus*.
10. *Method of transplanting*.—Has been experimented with on a small scale by transplanting plants 6" high entire with a handful of earth round the roots in July of the same year, and also by stump-plants from one year old nursery plants. Both methods were successful. Transplanting with seedlings from the natural forest with a handful of earth round the roots has given 50 per cent. success.
11. *Treatment after transplanting (weeding and cleaning)*.—As for *D. turbinatus*.
12. *Tending*.—As for *D. turbinatus*.
13. *Diseases and pests*.—As for *D. turbinatus*, but seeds of this species are more severely attacked.
14. *Rate of growth*.—Moderate. At Hazarikhil, Chittagong Division, the average rate of growth in plantations is as follows:—1st year—8"; 2nd year—2'; 3rd year—3'—3"; 4th year—4'—6"; 5th year—9'. Stem analysis of a tree at Hazarikhil, Chittagong Division, at plains level, gave a girth of 8'—7", height of 156', and a volume of 313 c. ft. down to 8" diameter in 118 years.

15. *General remarks*.—This species is much more exacting in respect of soil conditions than *D. turbinatus*. Also owing to its seed being badly attacked by insects, good seed is very difficult to obtain in any quantity. For this reason it is only put out in plantations over small areas where mother trees are to be found in the vicinity. A successful undersowing experiment was carried out in 1928 at Hazarikhil, Chittagong Division, in the 1922 *gamar* plantation with sowing *gurjan* seeds in *thalis* 6' × 6'. Though the mortality was large, about 86 per cent., yet at the end of 7 years the stocking appears adequate, spacing being 16' × 16' on the average, and height of plants 12' to 15'.

***Dipterocarpus tuberculatus* (In—Burm.).**

1. *Locality*.—An exotic from Burma. Occurs in a special type of deciduous forest known as *indaing* and found usually on *laterite*. The best *indaing* forest is found on flat or undulating land, on porous, well drained soil. Regenerates itself naturally in clear-felled areas.
2. *Seed time*.—First week of May.
3. *Weight of seed*.—70 winged seeds to the lb. 98 to the lb. with wings cut.
4. *Method of collection of seed*.—
5. *Method of treating seed*.—
6. *Method of seed storage*.—Seeds have arrived in good condition after 2 to 3 weeks in transit.
7. *Sowing (method and quantity of seed)*.—Seeds are sown direct immediately on receipt in May in line 6' apart with 2 rows of seeds in each line, seeds being 8" apart in each row. Seeds are *notched*, a process which consists of making a hole in the ground with the point of a *dao*, placing the seed in the hole and just covering the seed with earth leaving the wings sticking out. This prevents the seeds being dried up by the sun if at the time of sowing there happens to be no rain, and if after sowing there should be a drought. If sown in the nursery should be dibbled 4" × 4" in unshaded beds as soon after receipt as possible.
8. *Germination (time, percentage, etc.)*.—Germination commences in about 10 days and is complete within a month. 56 and 83 per cent. germination was recorded

in shaded and unshaded beds respectively. Direct sowing in the Silvicultural Garden at Hazarikhil, Chittagong Division, gave 47 per cent. success in the open and 23 per cent. under the shade of *boga-medeloa*.

9. *Treatment in nursery*.—Shading the bed appears harmful. Beds should be watered on dry days until the monsoon has set in.
10. *Method of transplanting*.—Has been successfully transplanted with small balls of earth when the plants were 2½" high in mid-August. Growth of transplants at the end of the first year is about the same as that of plants raised from direct sowing. Stump planting in the second rains is reported to be successful.
11. *Treatment after transplanting (weeding and cleaning)*.—Usual weeding and cleaning.
12. *Tending*.—
13. *Diseases and pests*.—White ants and other insects are found to attack the seeds both in the nursery and plantation. The young plants are also damaged by insects. Damage from the above causes has been estimated at 20 per cent. in the nursery bed.
14. *Rate of growth*.—7" to 1' in 1 year. Measurements recorded in Burma show that a tree in the natural forest attained a diameter of 22" and a height of 120' in 80 years.
15. *General remarks*.—This species has been tried at the request of the Forest Utilisation Officer, Bengal, as he reports that the timber of this species of *gurjan* commands a higher price than the others. Contrary to expectations seeds from Burma arrived in excellent condition. Has only been tried experimentally in the Silvicultural Nursery and Garden at Hazarikhil, Chittagong Division, and indications show that it will probably be most suited to the conditions in the Chittagong district. It would appear that shade is not necessary for growing this species and it should be possible to raise it without the help of a shade crop. It should do well on dry exposed south and west aspects and on the higher ridges, where the number of indigenous species of any value suited for such aspects is extremely limited.



**Duabanga sonneratioides** (*Lampate—Nep., Bandarkholla—Beng.*).

1. *Locality*.—Foot-hills up to 4,000' generally near *ghoras*. Also in the forests of the three Chittagong Divisions. Gives profuse regeneration on landslips and on freshly turned soil. It is therefore an excellent species for broadcast sowing on landslips, as the mineral soil thus exposed has been found to be most suitable for this species. Comes up naturally in plantations and as it is an extremely fast grower, it must be pulled up by hand at once or it will become a *wolf* tree and suppress the principal crop.
2. *Seed time*.—April-May.
3. *Weight of seed*.—8 lbs. of fruit gives 1 lb. of clean seed. The seeds are very minute and light and difficult to count; about 700,000 to the ounce.
4. *Method of collection of seed*.—Fruits when they start to turn black are collected from the trees by lopping the branches.
5. *Method of treating seed*.—The bunches of fruits are spread out on mats in the sun for 2 or 3 days to dry, which causes the fruits to open. Seeds are then removed by gentle thrashing. Seeds should be covered with a cloth during the process to prevent them being blown away by wind.
6. *Method of seed storage*.—Seeds can be successfully stored in a dry cool place until sowing time.
7. *Sowing (method and quantity of seed)*.—In Northern Bengal it is usually sown broadcast in lines 6' apart as this species is difficult to transplant. Should be sown fairly thickly as it is a poor germinator. 60 lbs. of clean seeds per acre for line sowing is used in Kalimpong foot-hills. The seed being light often gets washed into little heaps in the rains and so germinates in clumps. Seedlings should then be pricked out and evenly spaced in lines as soon as they are big enough to handle. Should not be sown direct on steep ground as found in the Chittagong district, as experience has shown that even when seeds have been mixed with ashes or mould they get washed away down the slopes. In the nursery seeds are sown soon after collection in shaded beds. The nursery bed should consist of sub-soil only without any admixture of leaf mould, as experience shows that it germinates best on sub-soil and this also reduces the amount of

weeding necessary. Seed should be sown fairly thinly to avoid pricking out. 4 ounces per *kamra* is sufficient. The seeds when sown either direct or in the nursery are mixed with ashes or mould to prevent them being blown away.

8. *Germination (time, percentage, etc.)*.—Germinates in 4 to 5 weeks and gives 25 to 30 per cent. success.
9. *Treatment in nursery*.—Careful watering must be done as seedlings are delicate and apt to damp off.
10. *Method of transplanting*.—Transplanted entire with balls of earth or a handful of earth round the roots when plants are small, 2" to 3" high, not later than August. Great care should be taken as this species is difficult to transplant, and if the tap root is at all damaged the plant is unlikely to survive.
11. *Treatment after transplanting (weeding and cleaning)*.—Owing to its rapid growth cleanings are seldom required after the second year.
12. *Tending*.—When sown in lines thinning will be necessary in the third year, in *thalis* in the fourth year, and thereafter every fifth year. A fairly heavy thinning is required owing to its rapid growth, and also it requires more room for development than most species owing to its umbrella-shaped crown, which if grown dense the tips of the branches become so badly damaged by rubbing against each other that trees take considerable time to respond to thinning. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests*.—Seeds are damaged by ants and therefore should be sown with a mixture of ashes and red lead. Not damaged by game. The Range Officer, Tista Range, reports that trees of plantations from 6 to 7 years old are frequently found dying off from the top. It has also been noticed in Sample Plot No. 1, Birrick, that healthy dominant trees, 17 years old, were dying off for no apparent reason. Also again in D.I.P. No. A, Mal Block, Kalimpong Division, a plot in the natural forest, all the trees died off stagheaded when about 4' in girth. This species is difficult to transplant owing to its delicate tap root and it may be that if the tap root ever strikes a hard pan, it becomes damaged and the tree gradually dies off.
14. *Rate of growth*.—Very fast. At Sambong, Darjeeling Division, at an elevation of 2,500', the average rate of growth in plantations is as follows:—1st year—1'; 2nd year—7'-2"; 3rd year—14'-5"; 4th year—22'-7"; 5th year—37'.

Sample Plot No. 2 of Kalimpong Division at Tarkhola, at an elevation of 1,200', gave an average diameter of 13.5", height of 94', and volume of 3,229 c.ft., per acre down to 8" diameter in 14 years. Sample Plot No. 4 of Darjeeling Division at Sambong, at an elevation of 2,700', gave an average diameter of 9.2", height of 123', and a volume of 6,505 c.ft. per acre down to 8" diameter in 27 years. Stem analysis of a tree at Mal, Kalimpong Division, at an elevation of 1,500', gave a diameter of 25", height of 128', and volume of 135 c.ft. down to 8" diameter in 68 years.

15. *General remarks.*—Owing to its horizontal habit of growth it would appear that in the final crop there will be so few trees per acre as to make the growing of this species in plantations uneconomic. For this reason and also, for reasons mentioned under paragraph 13, it is not considered a suitable species for putting out for production of timber in plantations and should be confined to sowing up landslips, embankments, etc. On the other hand it is suggested that owing to its very rapid growth both in height and diameter, that it might be suitable for putting out in plantations for production of fuel on say a 20-year rotation. It can be safely said that it will give a larger volume per acre than *Macaranga*, as the trees can be grown fairly close for *billet* size and will at the same time give a far bigger height growth. For this purpose, it is suggested a heavy thinning should be done in the fifth year and then be left without further thinning until the end of the rotation of 20 years. This would give a conveniently sized bole for splitting into *billets*.

***Eriobotrya petiolata* (Maya—Nep.).**

1. *Locality.*—6,000' to 8,000', best about 7,000'.
2. *Seed time.*—November-December.
3. *Weight of seed.*—175 seeds per lb.
4. *Method of collection of seed.*—Ripe fruits are collected direct from the trees.
5. *Method of treating seed.*—It is not necessary to remove the pulp before sowing.
6. *Method of seed storage.*—If properly spread, can be stored in a dry place.

7. *Sowing (method and quantity of seed).*—In nursery sowing is done in early February without shade. May also be sown direct in *thalis* 6' x 6', 2 to 3 seeds per *thali*.
8. *Germination (time, percentage, etc.).*—Germination 50 per cent. within 4 to 6 weeks.
9. *Treatment in nursery.*—Prick out early in May as by then the seedlings should be 4" to 6" high, and ready for transplanting by the beginning of June.
10. *Method of transplanting.*—Transplanted at stake 6' x 6' Natural seedlings from the forest have been successfully transplanted with balls of earth. Winter-planting is reported to be successful. Transplanting from the nursery is usually done without any earth round the roots.
11. *Treatment after transplanting (weeding and cleaning).*—Is a slow grower and frequent weedings will be necessary.
12. *Tending.*—
13. *Diseases and pests.*—
14. *Rate of growth.*—Slow. At Mahaldaram, Kurseong Division, at an elevation of 6,700', the average rate of growth in plantations is as follows:—1st year—1'; 2nd year—1'—9"; 3rd year—3'—2"; 5th year—6'—8". At Hum, Takdah Range, Darjeeling Division, at an elevation of 5,500', a tree attained a girth of 2', and height of 41' in 26 years. Stem analysis of a tree at Bagora, Kurseong Division, at an elevation of 7,000', gave a girth of 6'—10", height of 83', and a volume of 90 c.ft. down to 8" in diameter in 92 years.
15. *General remarks.*—Should not be grown pure as it does not give any side shade for the first two years at least. Is seldom put out now in Bengal. Is only useful to fill up vacancies at higher elevations where the choice of species is limited.

***Eucalyptus citriodora* (The lemon scented gum).**

1. *Locality.*—An exotic (an Australian species) cultivated in India in the Nilgiris, and Saharanpur, United Provinces. Seeds are obtainable from trees of excellent growth in Waddell Park, Tangail, Dacca-Mymensingh Division. Said to occur on hilly ground in its natural habitat.

2. *Seed time*.—Collected at Tangail in May-June and seeds gave only 7 per cent. germination, whereas seeds collected from Hazarikhil in April gave 42 per cent. From this it would appear that collection has been made too late at Tangail.
3. *Weight of seed*.—4,150 to 4,250 clean seeds to the ounce.
4. *Method of collection of seed*.—From the trees by lopping branches.
5. *Method of treating seed*.—Fruits are dried in the sun which causes them to open and seeds are separated by gentle thrashing. Seeds should then be dried in the sun for 3 or 4 days. Selection of seed may be done by placing them in water and rejecting the light ones which float to the top.
6. *Method of seed storage*.—Seeds have kept well for nearly 2½ months in gunny bags in a well ventilated shed.
7. *Sowing (method and quantity of seed)*.—Seed is mixed with earth and leaf-mould and sown broadcast in shaded nursery beds as soon after collection as possible. One ounce of seed per *kamra* should suffice. Direct sowing after mixing with ashes has been tried but this method is not recommended.
8. *Germination (time, percentage, etc.)*.—This species is not considered to be a good germinator, up to 7 per cent. only being recorded in the Silvicultural Nursery at Hazarikhil, Chittagong Division, but 42 per cent. has been recorded in shaded beds in the Silvicultural Nursery and Garden at Sukna, Kurseong Division, from seeds supplied from Hazarikhil. Germination starts in 20 days and is complete within 2 months. 2 per cent. germination has been obtained from direct sowing.
9. *Treatment in nursery*.—Usual standard method of weeding and watering.
10. *Method of transplanting*.—Plants have been transplanted by careful ball planting when about 3" high in the first week of July.
11. *Treatment after transplanting (weeding and cleaning)*.—Intensive cleanings are required in the first year as this species is intolerant of shade, but afterwards little attention is necessary as the growth is so fast.
12. *Tending*.—
13. *Diseases and pests*.—None noticed.

14. *Rate of growth*.—Fast growing. At Hazarikhil, Chittagong Division, the rate of growth is as follows:—7 months—3'—6"; 1 year 2 months—8'; 1 year 7 months—14'. A 5-year old plant reached a height of 40' with a diameter of 6". Considerable growth also takes place in the cold weather, 4'—6" being recorded between September and January.
15. *General remarks*.—Is very intolerant of shade and heavy cleanings must be done until this species gets above the height of the weed growth. Is doing quite well on a small scale in the Silvicultural Nursery and Garden, Hazarikhil, Chittagong Division, and as the rate of growth is exceptionally fast may be suitable for growing for box planking in the Chittagong district.

**Eucalyptus globulus** (*Blue gum*—Eng.).

1. *Locality*.—An exotic chiefly put out at Lopchu and Sonada, Darjeeling Division, from 5,000' to 6,000' elevation. There is one mature tree near the Darjeeling Improvement Fund Bungalow at Lopchu from which seeds can be collected. Seed is also obtained by indent through the Silviculturist, Madras.
2. *Seed time*.—Last week of March to middle of April.
3. *Weight of seed*.—18 lbs. of fruits give 4 ounces of clean seeds. Approximately 10,000 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are shaken from trees and collected in bags.
5. *Method of treating seed*.—Fruits are dried in the sun which causes them to open and seeds are separated by gentle thrashing. Seeds should then be dried in the sun for 3 or 4 days.
6. *Method of seed storage*.—May be stored for some time in a well ventilated shed but should be put out periodically in the sun to dry.
7. *Sowing (method and quantity)*.—Sown broadcast in the nursery in raised beds under shade in April. Seeds should be mixed with ashes or fine-earth to prevent them being blown away.
8. *Germination (time, percentage, etc.)*.—Germination reported to be up to 80 per cent. in 10 days.
9. *Treatment in nursery*.—Water sparingly and frequently with a very fine spray and never flood the bed. Seedlings are pricked out into *chungas* or baskets in July when they are from 2" to 4" high into shaded beds. 554 seedlings to the *kamra*.

10. *Method of transplanting*.—Is usual to transplant either in baskets or *chungas* or with balls of earth in July of the second year. Basket planting is not recommended unless they are made deep, as the baskets do not rot easily and the roots of young seedlings become mal-formed. Can be planted out any time after September in the hills.
11. *Treatment after transplanting (weeding and cleaning)*.—Rapid growth, so few cleanings are necessary after the second year.
12. *Tending*.—
13. *Diseases and pests*.—White ants do considerable damage. Stands frost well, but is badly damaged by snow and hail, and mortality from white ants, other insects, drought and water-logging is heavy. Is attacked by a borer, which is a species of *Phassus*, family *Hepialidae*. Young trees with juvenile leaves suffer badly from wind-break, the young tops of trees being frequently blown off. Many trees are found to be dying at Sonada, Darjeeling Division, for no apparent reason.
14. *Rate of growth*.—Very rapid. At Sonada, Darjeeling Division, at an elevation of 7,300', the average rate of growth in plantations is as follows:—1st year—3'—3"; 2nd year—4'—2"; 3rd year—12'; 4th year—15'—5"; 5th year—17'. Nine-year old plants in Lopchu compound gave an average girth of 2' to 3' and height of 48'.
15. *General remarks*.—Various other species of *Eucalyptus* such as *E. botryoides*, *E. corynocalyx*, *E. saligna*, *E. gigantea*, *E. regnans*, *E. maculata* have been tried, but none have done as well as *E. globulus*. *E. rostrata* was tried at Rajabhatkhawa in the Buxa Division and the trees that are surviving are doing well.

***Eugenia cymosa* (Khairjam—Chitg.).**

1. *Locality*.—Mixed evergreen forests; found chiefly in the Jaldi Range of the Chittagong Division and throughout Cox's Bazar. Occurs very sporadically towards the north-eastern part of the Ramgarh-Sitakund Range, Chittagong Division, and in the Chittagong Hill Tracts; on slopes and ridges, elevation up to 750'. Soil sandy loam to coarse sand.

2. *Seed time*.—Middle of April to the beginning of May and sometimes up to middle of May. Does not seed well every year.
3. *Weight of seed*.—200 seeds to the lb. just after treatment. 264 to the lb. when dry.
4. *Method of collection of seed*.—Fruits are collected from the ground around the seed-bearers or can be plucked from the tree when they turn black which is the sign of ripeness. All fruits do not ripen at once and so collection continues for a number of days.
5. *Method of treating seed*.—After collection fruits are heaped up in a shaded place to rot and the pulp is washed off by hand in water, and clean seeds are spread out in the shade to dry.
6. *Method of seed storage*.—Seeds when dried have been kept in a well-ventilated shed up to 6-8 weeks. It is preferable to sow as soon after collection as possible, as it has been found that the longer the seeds are kept the more they lose the power of germination.
7. *Sowing (method and quantity of seed)*.—Has been sown direct on an experimental scale at Bhomariaghona, Cox's Bazar Division. Seeds were dibbled in the lines 6' apart, 2 rows of seeds in each line, but the result was poor and few plants survived. Before sowing seed should be soaked in water over night and light seed rejected. In the nursery seeds are dibbled 3" x 3" in shaded beds. One pound of seeds are required for a *kamra*.
8. *Germination (time, percentage, etc.)*.—Germination is extremely poor and slow. In the experimental nursery at Hazarikhil germination commenced in a month and was complete in 3 months. Germination in shaded beds gave 11 per cent. and unshaded 5 per cent. On the other hand the Range Officer, Garjania Range, Cox's Bazar Division, reported 15 per cent. germination from direct sowing.
9. *Treatment in nursery*.—No special treatment except the standard method of weeding, and light watering until germination begins. It is advisable to give slight admixture of leaf mould. Owing to slow germination seedlings may have to be kept in the nursery until the second rains, and in such cases pricking out into shaded beds is advised.



10. *Method of transplanting*.—Larger seedlings can be transplanted in the first rains when 3" to 8" high with a little quantity of earth round the roots. Transplanting to be done on a wet day and soon after raising from the bed. Natural seedlings stand transplanting well and in the Garjania Range, Cox's Bazar, many were transplanted from the forest in June-July into the 1930 plantation area.
11. *Treatment after transplanting (weeding and cleaning)*.—Weeding throughout the rains. No other special treatment is required.
12. *Tending*.—At Bhomariaghona, Cox's Bazar Division, *boga-medeloa* was sown between the lines with the idea of affording shade to the species during the hot weather and also to keep down weeds. Observations have shown that growth is slightly better where the seedlings were in the open as compared with those shaded by *boga-medeloa*. From this it would appear that such shade may be harmful.
13. *Diseases and pests*.—None observed so far.
14. *Rate of growth*.—Very slow. 1st year—6"; 2nd year—1'; 3rd year—2'.  
Stem analysis of a tree at Machuakhali, Garjania Range, Cox's Bazar Division, gave a girth of 6'—0", height of 79', and a volume of 57 c. ft. down to 8" diameter in 90 years.
15. *General remarks*.—This species has only been tried experimentally on a small scale. Is a poor germinator and slow growing and for these reasons will never be popular, but as it appears to stand drought well it might be useful for putting out on exposed south and west aspects when other species are not available.

***Eugenia grandis*** (Dhakijam—Chitg.).

1. *Locality*.—Evergreen and mixed evergreen forests of the three Chittagong Divisions, not found pure but sporadically on all types of soil from the tops of dry ridges down to alluvial deposits on the lower slopes and bottoms of ridges. Soil sandy loam to loam; elevation up to 500'.
2. *Seed time*.—Mature fruits are available from the beginning of May up to the end of June, or even later on cooler aspects. Best time of collection is about the end of May to the beginning of June.

3. *Weight of seed.*—35 fruits to the lb. 85 clean seeds to the lb.
4. *Method of collection of seed.*—Fruits are collected from the trees or from the ground. It is better to collect from the ground as the fruits fall when ripe. This prevents the collection of unripe seeds.
5. *Method of treating seed.*—When sowing direct on a large scale it is now the practice not to remove the pulp and the outer coat and the fruit is sown whole without any treatment. When sown on a small scale in the nursery it is advisable to remove the pulp and the outer skin by hand to avoid damage by insects.
6. *Method of seed storage.*—Seeds do not keep longer than two weeks, and it is always best to sow as soon after collection as possible.
7. *Sowing (method and quantity of seed)*—The method recommended for raising *dhakijam* and which has been most successful in the Chittagong Division is by dense line-sowings with *boga-medeloa*. The combination of dense line sowings and *boga-medeloa* forces the plants up to the light and the rate of growth is faster than when grown in *thatis*. Fruits should be sown in lines 6' apart as soon after collection as possible, 2-3 rows of fruits in each line, the fruits being 8" apart in each row. It is essential that the *boga-medeloa* should be put out in the same year as the *dhakijam* in order to afford shade to the young seedlings during the first hot weather. With *taungya* crops *boga-medeloa* is sown thickly broadcast at the time of last cleaning of the *paddy* in July-August and any blanks are re-sown in September after the *paddy* has been reaped. If sown later than August the *boga-medeloa* will not be tall enough to afford shade to the young *dhakijam* in the first hot weather. In *regular* plantations *boga-medeloa* is sown in 1' wide lines in May of the first year. Besides affording shade to the young *dhakijam* the *boga-medeloa* also helps to keep down *assamlota* and so saves money in weeding and cleaning. In the nursery seeds are dibbled 3" x 3" in unshaded beds immediately after collection. Five pounds of seeds per *kamra* are required.
8. *Germination (time, percentage, etc.).*—Germination is excellent, commences in 3 weeks and is complete within 2 months and gives up to 90 per cent. success.
9. *Treatment in nursery.*—No special treatment is required except the standard method of weeding and slight watering. Leaf mould will certainly help, but is not an essential condition.

10. *Method of transplanting*.—Transplanted entire with a handful of earth round the roots in the first July—beginning of August when from 5"—9" high. This method has given 98 per cent. success. The height of plants raised by direct sowing and transplanting is the same at the end of the first year. Stump planting is a failure. *Boga-medeloa* should be sown in between the lines of *thalis* in the first year.
11. *Treatment after transplanting (weeding and cleaning)*.—Usual weeding and cleaning.
12. *Tending*.—*Dhakijam* cannot stand too much shade and great care should be taken to see that the branches of *boga-medeloa* over-topping the lines are kept sickled back so that the young *dhakijam* may get a certain amount of overhead light. Experiments have shown that while *boga-medeloa* is certainly a benefit to the crop in its first two years, it is definitely harmful from the beginning of the third rains onwards. *Boga-medeloa* should therefore either be very heavily thinned or coppiced back 6" below the level of the *dhakijam* plants before the beginning of the third rains. This is an important point and should not be lost sight of. Any *boga-medeloa* actually found in the *dhakijam* lines should be pulled up.
13. *Diseases and pests*.—None noticed so far.
14. *Rate of growth*.—Fairly fast. The following is the rate of growth in regular plantations at Bhomariaghona, Cox's Bazar Division:—1st year—2'; 2nd year—3'—6"; 3rd year—5'—6"; 4th year—8'; 5th year—10'. Stem analysis of a tree at Machuakhali in Garjania Range, Cox's Bazar Division, gave a girth of 6'—1", height of 71', and a volume of 61 c. ft. down to 8" diameter in 88 years.
15. *General remarks*.—In the natural forest appears to grow well both on dry upper ridges on south and west aspects as well as on the lower shaded slopes on the north and east aspects. Is therefore extremely useful for putting out on dry south and west aspects and on the tops of ridges, where the number of species suited to such aspects is extremely limited. The timber is popular locally especially for work involving submersion in water. It should, however, not be put out too extensively as it may not prove to be as valuable as other species in a wider market.

**Evodia meliaefolia** (*Thulo khanakpa*—Nep.).

1. *Locality*.—A tall deciduous tree common in the plains and foot-hills of Northern Bengal. Prefers a light sandy soil. Profuse natural regeneration is often noticed around mother trees.
2. *Seed time*.—November to February. Best time of collection is December. Good seed years occur annually.
3. *Weight of seed*.—2,358 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the trees by lopping the branches. Fruits turn black as an indication of ripeness.
5. *Method of treating seed*.—Seeds are extracted from fruits by hand. Husks are separated by winnowing. Seeds are then dried in the sun for a few days.
6. *Method of seed storage*.—Seeds are not stored and should be sown as soon after collection as possible.
7. *Sowing (method and quantity of seed)*.—Direct sowing in May-June has been tried for several years and the results are a complete failure, and this method is not recommended. Should be sown broadcast in shaded beds in the nursery immediately after collection and a light layer of leaf mould sprinkled over them. One pound of seed per *kamra* will suffice.
8. *Germination (time, percentage, etc.)*.—Thirty per cent. in shaded beds in the nursery and 15 per cent. in unshaded beds. Germination starts in one month and is complete within 5 months.
9. *Treatment in nursery*.—Usual standard method of weeding and watering. Ashes should be sprinkled over the beds to prevent attacks by ants. Pricking out is not done as plants are put out the same year. Shades should be removed some days before transplanting.
10. *Method of transplanting*.—Transplanted entire with balls of earth in July of the first year, when seedlings are about 16"—6" in height with 80 per cent. success. Winter transplanting entire with balls of earth in December of the first year when plants were 2' high gave cent. per cent. success. Stump planting with plants in their first or second rains gave 80 per cent. success. About 0.8" diameter at the collar appears to be the most suitable size for stump planting.

11. *Treatment after transplanting (weeding and cleaning).*—Usual weeding and cleaning. Is a light demander and no cover crop is required. Heavy cleanings will be required until the plants are above weed growth. Is fast growing and no cleaning should be necessary after the first rains.
12. *Tending.*—
13. *Diseases and pests.*—None noticed up to date.
14. *Rate of growth.*—Very fast. The following is the rate of growth in the plantations at Sukna, Kurseong Division:—1st year—11'—6"; 2nd year—7'; 3rd year—12'; 4th year—18'.  
Sample Plot No. 36 at Mangwa, Darjeeling Division, at an elevation of 2,500', gave an average diameter of 4.1" and height of 45' in 6 years.
15. *General remarks.*—Is reported to be a good match wood. Very fast growing and all methods of regeneration are easy except by direct sowing. As it gives a very light canopy should be suitable for growing in alternate lines with slow growing shade bearers.

**Gmelina arborea** (Gamar—Beng., Khamari—Nep.).

1. *Locality.*—In Northern Bengal found scattered in the plains and lower hills up to 3,000'. Grows best on light silt in the neighbourhood of rivers. In the three Chittagong Divisions, occurs sporadically both in the deciduous and evergreen forests. Seems to prefer a southern or south-western aspect. Soil sandy loam and *must be well-drained*. It is a common habit to put out this species on soil that is too clayey for it and not well-drained, such as low depressions along the banks of rivers in the Chittagong Hill Tracts, and in the older plantations at Godamdabri, Buxa Division. Although this species may look well for the first 5 or 10 years, in such areas, after a time it begins to look unhealthy, the tops die off and the rate of growth is checked. It was noticed that the attacks both by *loranthus* and defoliators on *gamar* in the Chittagong Hill Tracts were much more severe in areas that were liable to water-logging. For these reasons much greater care must be taken to select only well-drained sites. Has been put out pure over large areas in the Chittagong Hill Tracts Divisions with success,

but on the dry sandy loam slopes of the Chittagong and Cox's Bazar Divisions the results have been extremely disappointing. Pure plantations of this species should not on any account be put out in future.

2. *Seed time*.—In Northern Bengal second week of April to the end of May. In Southern Bengal May to second week of June.
3. *Weight of seed*.—Northern Bengal, 1 lb. of fruit yields 1 ounce of clean seeds. 50 seeds to the ounce. Chittagong Hill Tracts, 26 to the ounce. It is reported from Northern Bengal that the germination and growth from seeds obtained from the Chittagong Hill Tracts is much better than the local seed, and for this reason Divisions in Northern Bengal usually obtain their seeds from Chittagong Hill Tracts. One two-maund gunny bag of cleaned seed weighs about  $1\frac{1}{2}$  maunds.
4. *Method of collection of seed*.—Fruits are collected from the ground. Before collection ground under mother trees should be cleaned and seeds collected frequently so as to avoid collecting damaged seed. Brown fruits are the best, black and green fruits should not be collected.
5. *Method of treating seed*.—Fruits are heaped under shade for 4 or 5 days to allow the pulp to rot or are buried in a pit for the same period. Pulp is then either removed by hand or washed off in water. Seeds should be dried in the sun for 2 or 3 days. Seeds collected from the droppings of cattle and washed and dried are reported to give a better percentage of germination.
6. *Method of seed storage*.—Seeds may be stored in bags in a dry well-ventilated shed until the time of sowing. Seeds, if carefully stored, can be kept for a year, but this is not recommended as the germination per cent. is not as nearly as good as that from fresh seed.
7. *Sowing (method and quantity)*.—In Northern Bengal where the rate of growth is slower than in Southern Bengal, seeds are dibbled direct in lines 6' apart and 4" to 8" apart in the lines. Height growth of plants, sown closely in lines, is much quicker than in *thalis*, as in the latter, the plants tend to form big crowns, whereas in lines the plants are drawn up quickly and so are sooner out of danger from weeds. In Chittagong Hill Tracts, is sown in *thalis* 6' apart 3 to 4 seeds per

*thali*. For sowing in *thalis* 4 seeds per *thali*, about 12 lbs. of seeds per acre are required. *Must not be put out pure*. In Northern Bengal should be put out either in groups of lines mixtures with species of roughly the same rate of growth, or in alternate lines with slower growing shade bearers such as *bonsum* (*Phoebe hainesiana*), *khutikat* (*Polyalthia simiarum*), *rakthan* (*Lophopetalum fimbriatum*), *setisal*, etc. Dense line sowings of either *chikrase*, *Cedrela toona* or *C. microcarpa* with *gamar* dibbled 12' x 12' in their lines would also appear to be another suitable method for raising this species. In the Chittagong Hill Tracts Division experiments have been carried out with *gamar* in alternate lines with shade bearers with the object of affording shade to the shade bearers during their first few years, and at the same time to keep down that pernicious pest *assamlota* and so save cost in cleanings. The outstanding successes have been *gamar* with *tali* and *gamar* with *gurjan* (*Dipterocarpus turbinatus*). The former success is unqualified and this method will presumably be adopted as a standard for raising *tali* in this Division. Lines are 6' apart, *tali* being raised by dense line sowings and *gamar* dibbled 6' apart in its line. As regards the *gamar-gurjan* mixtures it is not yet certain whether alternate line or alternate groups of lines mixtures will be the best; although the former looks promising a great deal of tending among the *gamar* has been necessary to let the *gurjan* develop and the cost of this may prove to be as high as that of cleaning in the groups of *gurjan* lines. Experiments with different spacing both between the lines of *gamar* and *gurjan* and in the *gamar* line itself are being carried out to find out the most suitable spacing which, besides affording sufficient shade to keep down *assamlota*, will at the same time not suppress the young *gurjan* unduly. Alternate line mixtures with *mahogany* and *gamar* have not been so successful although the former looks healthy, its rate of growth, as compared to that in the open, is extremely slow, and it appears difficult to get the spacing of *gamar* so as to give a shade dense enough to keep down *assamlota* and at the same time to let in enough light for the satisfactory growth of *mahogany*. If sown in the nursery, is dibbled 3" x 3" in unshaded beds. Seeds should be sown as early as possible in March-April, so as to be large enough to transplant in June, when plants will be

about 1' in height. One year old seed is used for this purpose. In Chittagong Hill Tracts, each *Jhumia* usually makes a small temporary nursery of a few square feet to fill up the vacancies in his *jhum*. Seeds should be sown  $\frac{1}{2}$ " deep, whether direct or in the nursery.

8. *Germination (time, percentage, etc.).*—Germination takes place within 10 to 15 days with 80 per cent. success.
9. *Treatment in nursery.*—No special treatment is required except the standard method of weeding and watering. Pricking out is not necessary.
10. *Method of transplanting.*—Transplanted in June entire, with or without a handful of earth round the roots. Transplanting is not recommended except to fill up vacancies as plants tend to die back after transplanting and so growth is checked. Planting with root and shoot cuttings has been very successful.
11. *Treatment after transplanting (weeding and cleaning).*  
—Weeding is seldom necessary after the second year as by then the canopy will be closed and only climber-cutting will be required.
12. *Tending.*—When sown in lines or *thalis* excess plants may be used for filling up vacancies, otherwise they should be cut out at the time of the first cleaning in the second year in order to give the remaining plants room to develop. In line sowing the plants should be evenly spaced about 3' apart. The stripping of leaves and branches, with the exception of the leading shoot, in the first cold weather, probably strengthens it and reduces the food-supply of the defoliator which always attacks the tree. Plantations sown in lines require thinning in the third year, and those sown in *thalis*, in the fourth or fifth year. Thinnings should be fairly heavy (D Grade Ordinary) as *gamar* is an intense light demander and requires a clear space round its crown in order to develop properly. Also it has been noticed that the attacks of defoliators and *Loranthus* are not anywhere near so severe and serious in plantations that have been heavily thinned and, where the crowns are large and not at all restricted. Under-thinned plantations always look sickly. Thinning of this species has been the subject of a separate note.



13. *Diseases and pests.*—Squirrels dig up and eat the seeds after sowing, a real menace. In its first two years the leading shoots are badly browsed by deer and from this age onwards deer gnaw the bark to the extent of girdling the tree, sometimes year after year until the tree is killed; whole plantations of 20 acres and more have been completely destroyed in the Chittagong Division. For this reason in areas where deer are frequent *gamar* should only be grown in fenced plantations. Chittagong Hill Tracts appears to be the only Division in which *gamar* can be put out in unfenced plantations, and even here the damage has been more severe in the last few years. Is often attacked and completely defoliated by *Calopepla leayana*, but up to the present this has not been very serious, in that plantations put out on land suited to them seldom appear to be attacked 2 years in succession, and so the plants have time to recover. It is interesting to note that all the plantations at Kaptai were defoliated in 1931-32 with the exception of 1926 plantation which was the only plantation to be attacked in 1930-31. The same borers as attack *teak*, *Dihammus cervinus* and especially *Glenea indiana* are often in evidence and have been exceptionally severe in Dhobacherri plantations, Chittagong Division; these burrow into the stems and kill young poles and saplings. White ants are also responsible for casualties. Healthy 5-year old plants have been killed by fungus at Rajabhatkhawa. Plantations in the Chittagong Divisions, especially at Kaptai, were very severely attacked by *loranthus* (*Loranthus scurrulla*) during the year 1931-32. This has become a very serious pest and in areas not quite the optimum for *gamar* (inclined to be water-logged), up to 60 per cent. trees have been attacked and many killed outright within 6 months.

14. *Rate of growth.*—Very fast. The average rate of growth in plantations in the Chittagong Hill Tracts is as follows:—1st year—5'; 2nd year—17'; 3rd year—25'—6"; 4th year—33'; 5th year—36'.

Sample Plot No. 7 of Buxa Division at Rajabhatkhawa at plains level gave an average diameter of 8.4", height of 70', in 11 years. Sample Plot No. 1 of Chittagong Hill Tracts Division at Kaptai at plains level gave an average diameter of 9.5", height of 79', and a volume of 1,144 c. ft. per acre down to 8" diameter in 11 years.

Stem analysis of a tree at Sanghai Road in Jainti Range, Buxa Divisions, at plains level, gave a girth of 8', height of 95' and a volume of 100 c. ft. down to 8" diameter in 40 years.

15. *General remarks*.—Owing to the numerous pests by which this species is liable to be attacked, specially *loranthus*, no pure plantations should be put out. Also *gamar* is very light-demanding, and in the older plantations trees have become so widely spaced that it would appear that the final yield will be so small as to make the growing of this species uneconomic. Under-sowing *gamar* plantations with *Dipterocarpus turbinatus* and *tali* has been extremely successful. As mentioned under paragraph 7, experiments have been carried out with mixtures of *gamar* with certain shade bearers. These experiments should be extended in order to try other species such as *telsur*, *kamdeb* and other of the more valuable shade bearers to be found in the forests of Chittagong and Chittagong Hill Tracts Divisions.

#### ***Hopea odorata* (Telsur—Chitg.).**

1. *Locality*.—Found chiefly in the mixed evergreen and deciduous forests of Chittagong and Cox's Bazar Divisions also sporadically in the Chittagong Hill Tracts. On cooler aspects on the lower slopes and along the edge of streams. Soil silt to sandy loam. Regenerates itself profusely round about mother trees. In order to raise natural regeneration successfully the overhead canopy should be completely removed. Elevation up to 500'.
2. *Seed time*.—Beginning to end of May and sometimes up to the first week of June, when seeds start germinating *in situ*. It only appears to seed every alternate year. Best seed is obtained in last week of May. If carefully handled germinating seeds will give good results.
3. *Weight of seed*.—880 seeds with wings to the lb.
4. *Method of collection of seed*.—From the ground under and around seed-bearers; can also be collected by lopping the smaller branches.
5. *Method of treating seed*.—Seeds should be spread out in the shade to dry.
6. *Method of seed storage*.—Seeds cannot be stored longer than a week, and should be sown as early after collection as possible.

7. *Sowing (method and quantity of seed).*—Very light seeds should be rejected. Seeds are sown direct thickly in lines 6' apart in conjunction with *boga-medeloa*, 3 rows of seeds to a line, the seeds being about 6" apart in each row. Seeds are laid flat and covered with soil of a depth equal to the smallest diameter of the seed, wings left sticking out on the surface. It is essential that *boga-medeloa* should be put out in the same year as the *telsur* in order to afford shade to the young seedlings during the first hot weather. With *taungya* crops *boga-medeloa* is sown thickly broadcast at the time of last cleaning of the paddy in July-August and any blanks in the line are resown in September after the paddy has been reaped. If sown later than August the *boga-medeloa* will not be tall enough to afford shade to the young *telsur* in the first hot weather. In regular plantations is sown in 1' wide lines in May of the first year. Besides affording shade to the young *telsur* the *boga-medeloa* also helps to keep down *assamlota* and so save money in weeding and cleaning. In the nursery seeds are dibbled 3"  $\times$  3" in shaded beds. 1 lb. of seed per *kamra* is required.
8. *Germination (time, percentage, etc.).*—Germination commences in a week and is complete within about one month; 50 per cent. in unshaded, 63 per cent. in shaded beds, and 40 per cent. from direct sowing are recorded. General condition is slightly better in shaded than in unshaded beds during the first year of growth.
9. *Treatment in nursery.*—No special treatment is required except usual weeding and slight watering. Leaf-manure will certainly help but is not an essential condition. It is advantageous to loosen the soil occasionally round the plants.
10. *Method of transplanting.*—Transplanted entire in early August of the same year 6'  $\times$  6' with a handful of earth round the roots when the plants are 4" in height, and should be planted immediately after raising from the beds. This has given 70 per cent. success. It is reported that the rate of growth is faster and the general condition of plants put out as transplants is better than those raised by direct sowing. Root and shoot cuttings are successful with plants kept in the nursery until the second rains. Seedlings from the forest have been transplanted into plantations with success. *Boga-medeloa* should be sown in between the lines of *thalis* in the first year.

11. *Treatment after transplanting (weeding and cleaning).—*Usual weeding and cleaning
12. *Tending.*—*Telsur* is not so tolerant of shade as *tali* or the *gurjans*, or even so much as *dhakijam*. Therefore the object of growing *boga-medeloa* with this species is not so much to afford shade to the young plants as to keep down *assambota* and so save money in cleanings. Great care should therefore be taken to see that the branches of *boga-medeloa* over-topping the lines are kept sickled back especially during the rains so that the young *telsur* plants may get the full overhead light. Experiments have shown that while *boga-medeloa* is a certain benefit to the crop in its first two years, it is definitely harmful from the beginning of the third rains onwards. *Boga-medeloa* should either therefore be very heavily thinned or coppiced back 6" below the level of the *telsur* plants before the beginning of the third rains. This is an important point and should not be lost sight of. Any *boga-medeloa* actually found in the *telsur* lines should be pulled out.
13. *Diseases and pests.*—Attacks by defoliators have frequently been noticed towards the close of the rains and continue until the end of the hot weather, when new and healthy leaves appear. Saplings in the natural forest have been found to be attacked by stem-borers. Seeds are sometimes badly attacked by insects.
14. *Rate of growth.*—Comparatively slow. Average rate of growth in plantations is as follows:—1st year—9"; 2nd year—2'; 3rd year—4'; 4th year—5'—6"; 5th year—7'—6". Diameter Increment Plot No. 2 in the natural forest at Bhomariaghona, Cox's Bazar Division, at plains level, gave a tree with a height of 45', and a diameter of 6" in 30 years.
15. *General remarks.*—Should be confined to the lower slopes of ridges on north and east aspects preferably on silt or sandy soil. Direct sowing and transplanting and stump planting are all successful. It is a hardy species and can persist although it will not grow under the densest shade of *assambota* without being killed off. Experiments should be made with a mixture of alternate lines of *telsur* and *gamar* as it would appear that the higher shade given by *gamar* would be more suitable to this species than the low shade given by *boga-medeloa*.

**Hevenia dulcis** (Bangi—Nep.).

1. *Locality*.—Northern Bengal from the plains up to 5,000'. Grows best above 2,000' in *ghoras* and valleys with good soil.
2. *Seed time*.—January to first part of February. Best time to collect is the latter part of January. Seeds well every year.
3. *Weight of seed*.—1,200 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected by lopping branches. Fruits turn yellow as an indication of ripeness.
5. *Method of treating seed*.—Fruits are spread in the sun to open and seeds are removed by gentle thrashing.
6. *Method of seed storage*.—Seeds are not stored and should be sown as soon after collection as possible.
7. *Sowing (method and quantity of seed)*.—Sown broadcast in shaded nursery beds as soon after collection as possible, so as to get plants big enough to put out in the first rains.  $\frac{3}{4}$  lb. of seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.)*.—Germination complete within one month giving about 50 per cent.
9. *Treatment in nursery*.—Prick out into shaded beds 3"  $\times$  3" when plants are about 3" in height.
10. *Method of transplanting*.—This species is extremely hardy and easy to handle and can be put out in both first and second rains and also both in the first and second cold weathers with cent. per cent. success. It is advisable, however, in order to save nursery work to put it out in the first July-August and to fill up vacancies in the first cold weather.
11. *Treatment after transplanting (weeding and cleaning)*.—Weeding and cleaning as required up to the end of the second year.
12. *Tending*.—
13. *Diseases and pests*.—None noticed up to date.
14. *Rate of growth*.—Fairly fast growing. Average rate of growth in plantations at Takdah, Darjeeling Division, at an elevation of 5,500', is as follows:—1st year—2'; 2nd year—4'—6"; 3rd year—7'—6".  
Stem analysis of a tree at Lopchu, Darjeeling Division, at an elevation of 4,500' gave a girth of 6'—8", height of 93', and a volume of 100 c.ft. down to 8" in diameter in 44 years.
15. *General remarks*.—

**Hymenodictyon excelsum** (*Latikaram* or *Latijara*—Nep.).

1. *Locality*.—Found in dry mixed forests and *sal* forests of the plains and foot-hills of Northern Bengal. More common in the forests west of the Tista than elsewhere. Prefers sandy soil. Regenerates itself under suitable conditions.
2. *Seed time*.—December to mid-February. Best time of collection is first half of February. Good seed years appears to be annual.
3. *Weight of seed*.—4,000 clean seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from trees by lopping branches. Fruits turn reddish brown as an indication of ripeness.
5. *Method of treating seed*.—Fruits are spread in the sun on a mat and when fruits open out seeds are extracted by hand. Seeds are then dried in the sun for a few days.
6. *Method of seed storage*.—Seeds can be stored in gunny bags in a well ventilated shed until ready for direct sowing in May.
7. *Sowing (method and quantity of seed)*.—Seeds are sown direct in lines 6' apart in May. In the nursery seeds are sown thinly broadcast in unshaded beds\* directly after collection. 2 ounces of seeds per *kamra* will suffice. Seeds should be sown immediately after collection in order to get plants big enough to put out in the first rains.
8. *Germination (time, percentage, etc.)*.—Germination takes place in 2 months and is complete within 4 months, giving 35 per cent. in shaded nursery beds, 30 per cent. in unshaded, and 20 per cent. in direct line sowings.
9. *Treatment in nursery*.—Standard method of weeding and watering. Shades are unnecessary. No pricking out is necessary if the plants are put out the same year.
10. *Method of transplanting*.—Easy to handle. Transplanting with balls of earth after the break of the first rains, in June when about 8" high has been completely successful. Winter transplanting with balls of earth when about 10"—12" high in their first cold weather is also completely successful. Stump planting with plants in the second rains has given cent. per cent. success. Stumps of about  $\frac{3}{4}$ " diameter at the collar would appear to be the best size.

11. *Treatment after transplanting (weeding and cleaning).—*Slow at first and several weedings and cleanings will be required in the first two years. Is light demanding and cannot stand suppression by weeds.
12. *Tending.—*
13. *Diseases and pests.—*Leaves are sometimes attacked by defoliators.
14. *Rate of growth.—*Slow for the first two years and thereafter fast. Rate of growth in plantations at Sukna, Kurseong Division, at an elevation of 500', is as follows:—1st year—1'; 2nd year—3'—6"; 3rd year—6'.
15. *General remarks.—*Is reported to be suitable for boxplanking and matchwood. Extremely easy to regenerate under all methods. Might deserve more attention.

**Juglans regia** (Walnut—Eng., *Okhar*—Nep., *Akrot*—Hind.).

1. *Locality.—*Northern Bengal from 3,000' to 8,000', best 4,000' to 6,000', particularly in *ghoras* and old charcoal kiln sites. Seems to do best on slopes on southern and western aspects. Gives good seed every year but young seedlings are seldom found.
2. *Seed time.—*September-October. Seeds well every year. • Seeds are also obtained by indent through the Silviculturists, United Provinces and Punjab.
3. *Weight of seed.—*28 to 40 seeds per lb.
4. *Method of collection of seed.—*Collected by shaking and beating branches to make fruits fall. Fruits that have previously fallen should not be collected as these are usually insect-attacked.
5. *Method of treating seed.—*The outer fleshy coat should be removed by hand or fruits may be left to rot in heaps for a few days until the pulp falls off. The seed should then be dried in the sun for 4 to 5 days.
6. *Method of seed storage.—*Water test for the seed should be carried out before storing and a similar test before sowing, and unsound seed rejected. Seeds may be stored in a well-ventilated shed until the time for sowing, and may with advantage be put out occasionally in the sun to dry. Seeds have also been stored by digging a hole in the ground and filling up with seeds up to 18" from the surface which is then filled up with earth. Great care must be taken to see that the ground is perfectly dry, neglect of this point may result in heavy loss.

7. *Sowing (method and quantity of seed).*—In most Divisions direct sowing is done in *thalis* 6' x 6' in February and March, as the results are now considered to be more successful than transplanting. Two seeds per *thali* is the practice. Seeds are liable to be dug up by the villagers and so *skeleton*\* *stakes* should be used. If sown in the nursery seeds are dibbled 3" x 3" or 4" x 4" in unshaded beds in March. Manuring of beds is definitely harmful and should not be done.
8. *Germination (time, percentage, etc.).*—Germination takes from 5 to 7 weeks according to elevation. The higher the elevation the slower the germination. Germination up to 70 per cent. has been obtained.
9. *Treatment in nursery.*—Pricking out is not usually done.
10. *Method of transplanting.*—Transplanting is done entire with or without balls of earth in the first cold weather in January and February when the plants are leafless.
11. *Treatment after transplanting (weeding and cleaning).*—In all *walnut* plantations a little tallying round the plants would be very beneficial and can be carried out with advantage.
12. *Tending.*—
13. *Diseases and pests.*—Seeds are eaten by man, squirrels and rats. Is often badly attacked by shoot-borers. Also damaged by a stem-borer probably the same as attacks *utis*. At Batasi in Darjeeling Division a large number of poles were killed by a root fungus.
14. *Rate of growth.*—Fairly fast. At Rambh, Darjeeling Division, at an elevation of 6,600' the average rate of growth in plantations is as follows:—1st year—8"; 2nd year—4'—8"; 3rd year—5'—7"; 4th year—12'; 5th year—14'.  
D. I. P. No. 5 at Batasi, Darjeeling Division, at an elevation of 7,800\* gave an average diameter of 6.2", and height of 49' in 18 years. Stem analysis of a tree at Lopchu, Darjeeling Division, at an elevation of 5,300' gave a girth of 6'—6", height of 95' and volume of 107 c.ft. down to 8" diameter in 53 years.
15. *General remarks.*—Sowing of this species must be confined to sheltered *ghoras* and hollows. Observations show that it does not do well on ridges.



**Lagerströmia flos-reginae** (Jarul—Beng.).

1. *Locality*.—Occurs naturally in the three Chittagong Divisions and on the extreme east of the Buxa Division. It does not appear to be too particular as to soil and is found growing in the Chittagong Hill Tracts equally well on the top of dry exposed ridges, as well as along river banks on low swampy ground. It stands temporary submersion and appears to do well on water-logged soil. For this reason it is planted chiefly in Southern Bengal in areas liable to water-logging, and in Northern Bengal in areas too damp for *sal* and miscellaneous species.
2. *Seed time*.—In Southern Bengal end of November to middle of January, best time to collect is in December. In Northern Bengal January and February.
3. *Weight of seed*.—175 fruits to the lb. which gives 5 ounces of clean seeds. 3,125 seeds to the ounce. One 2-maund gunny bag of cleaned seeds weighs from 32 to 40 lbs.
4. *Method of collection of seed*.—Fruits are collected from the trees as soon as the capsules start to open. Great care must be taken to see that only ripe seed is collected as there have been many failures in the past owing to the early collection of immature seed.
5. *Method of treating seed*.—Fruits are spread out on mats in the sun for a few days until the capsules are fully open when the seeds are extracted by hand or by gentle thrashing.
6. *Method of seed storage*.—Seeds can be stored in a dry and well-ventilated shed and occasionally spread out in a shaded place to air. Can be kept for a year, but it is preferable not to keep the seeds longer than up to the time of sowing (April-June) as one year old seed does not give such good germination and only 20 per cent. is reported.
7. *Sowing (method and quantity of seed)*.—Usually sown direct. In Southern Bengal sowing is done either broadcast in lines 4' apart or in *thalis* 4' × 4', a few seeds in each *thali*. Six pounds of seed per acre are used for sowing 4' × 4'. In Northern Bengal when sown in depressions in *sal* plantations is sown continuous with *sal* in lines 6' apart; about 14 lbs. of seed per acre is required for *thali* sowing. This species must be sown close owing to its habit of forking and branching. Sowing is done in Southern Bengal at the end of April

and May, before the first break of the monsoon as with the first heavy rains the seeds are liable to be washed down the slopes. In Northern Bengal is sown in May and June. Seeds are covered with a light layer of soil. If sown in the nursery, sow thinly broadcast in shaded beds in February-March with a layer of soil over the seeds. About 8 ounces of seed per *kamra* will suffice.

8. *Germination (time, percentage, etc.)*.—Germination up to 90 per cent. within 10 to 30 days. Germination can be speeded up by first soaking seed in water for 12 hours immediately before sowing.
9. *Treatment in nursery*.—Seeds should be sown thinly broadcast and no pricking out is required.
10. *Method of transplanting*.—Transplanted entire with or without a handful of earth round the roots in June of the first year when about 4" to 6" high. Root and shoot cuttings do extremely well. Buxa Division reports when planting up low areas that pre-monsoon stump-planting in April is far more satisfactory than stump planting in the rains, both as regards rate of growth and percentage of survivals. The growth of rains stumps is hardly any better than from direct sowing. The most satisfactory stump is about 0.8" diameter at the collar, which means that the seedlings are not usually ready for stumping until the second rains. Winter transplanting with plants in their first cold weather has given cent. per cent. success.
11. *Treatment after transplanting (weeding and cleaning)*.—Frequent cleanings are necessary in the first 3 or 4 years especially in Southern Bengal, in areas infested with *assamlota*. The growth of this species is considerably retarded by shade and for this reason neither departmental crops such as *jute* nor cover-crops such as *boga-medeloa* should be grown with this species.
12. *Tending*.—This species looks very disappointing for the first 5 or 6 years owing to its seemingly crooked growth and branching habit. It straightens up from the 6th to 8th year when the trees begin to look very promising. Cutting of double stems is done in the second or third year. The thinning of this species has been the subject of a separate note.
13. *Diseases and pests*.—Caterpillars of *Lymantriidae* are reported as defoliators of young plants. A few trees have been attacked by *loranthus* at Kaptai, Chittagong Hill Tracts Division.

14. *Rate of growth*.—Fast after the first two years. In the Chittagong Hill Tracts Division the average rate of growth in plantations is as follows:—1st year—2'; 2nd year—8'; 3rd year—13'; 4th year—18'; 5th year—20'.

Sample Plot No. 20 at Rajabhatkhawa in Buxa Division, at plains level, gave an average diameter of 6.2", and height of 50' in 13 years. Sample Plot No. 4 of Chittagong Hill Tracts Division at Kaptai, at plains level, gave an average diameter of 8", and height of 67' in 15 years. Stem analysis of a tree in the Kasalong Range, Chittagong Hill Tracts Division, gave a girth of 6'—9", height of 100', and volume of 126 c. ft. down to 8" in diameter in 77 years.

15. *General remarks*.—Is an exceptionally valuable timber and the most suitable species for sowing in hollows and depression in both *teak*, *sal* and miscellaneous plantations. Stands temporary submersion in water. Plants at Mainimukh have been submerged for 10 days and as soon as the water subsided the leading shoots gave out new leaves, and the plants were as healthy as ever in the cold weather. As this species is so valuable it is suggested that it should not be confined only to low wet areas as it is at present, but should be put out on a larger scale to replace some of our less valuable miscellaneous species.

#### ***Lagerstrœmia hypoleuca* (Jarul).**

1. *Locality*.—An exotic from the Andamans where it is chiefly found in deciduous forests, on low ground on sandy soil. It extends into evergreen forests where it is associated with various species of *Dipterocarps*. Suitable in Bengal for sowing in wet, low-lying land in plantations.
2. *Seed time*.—Seeds are indented from the Chief Forest Officer, Andamans. They ripen in the cold weather and are usually received in April-May.
3. *Weight of seed*.—6,500 clean seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the tree before they dehisce.
5. *Method of treating seed*.—Fruits are dried in the sun for a few days until the capsules are fully open when seeds are extracted by hand or by gentle thrashing.

6. *Method of seed storage*.—Seeds should be stored in a well-ventilated shed until sowing time in May-June.
7. *Sowing (method and quantity of seed)*.—Seeds are usually sown direct and are either broadcasted in lines 6' apart or in *thalis* 4' x 4' and covered with a sprinkling of earth. Eight pounds of seeds are required for an acre for line sowing. Broadcasting must be done fairly thickly and plants must be kept close when young. If sown in the nursery seed is sown broadcast in shaded beds in the latter part of April. They should be sown thinly to avoid pricking out. Half ounce of seeds per *kamra* will suffice.
8. *Germination (time and percentage, etc.)*.—Germination starts in a fortnight and is complete within 2 months. Germination percentage is good from 80 to 90 per cent. being recorded.
9. *Treatment in nursery*.—Usual watering and weeding should be done. Seedlings should be pricked out from congested clumps in the bed. This is usually done about 2 months after sowing.
10. *Method of transplanting*.—Seedlings are ready for transplanting at the end of July to middle of August of the same year when 4" to 6" high. As this species tends to branch and fork badly it must, when young, be grown close. It should, therefore, be put out 4' x 4'. Transplanting is done entire with a handful of earth round the roots. Has been kept in the nursery until the second rains and transplanted when 2' high. A small scale experiment with root and shoot cuttings of 2-year old seedlings was carried out at Sukna with excellent results. It is not known if pre-monsoon stump planting will be more successful than rains stump planting, and this should be tried. Winter transplanting with plants in their first cold weather has been very successful.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—Shade is harmful at least during the first year and it was noticed at Sukna that the growth of the plants under *jute* was half of that in the open. Therefore, the use of *boga-medeloa* with this species is not recommended. The thinning of the ~~plants~~ is the subject of a separate note.
13. *Diseases and pests*.—None yet found.

14. *Rate of growth*.—Fairly fast from the third year. The following is the average rate of growth in plantations:—1st year—6'—1"; 2nd year—8'; 3rd year—13'; 4th year—18'; 5th year—21'.  
Buxa Division reports that a 10-year old plantation averaged 40' in height with a girth of 1'—8". The rate of growth in Northern Bengal is identical with that of *Lagerstræmia flos-reginæ*, and like the latter grows crooked and knotty at first but afterwards straightens up.
15. *General remarks*.—Does not grow on higher ground as is the case with *L. flos-reginæ*, and should, therefore, be confined to low ground and depressions.

***Litsæa panamonja* (Dude-lampate—Nep.).**

- Locality*.—Plains and foot-hills of Northern Bengal. Very common in the foot-hill forests of the Kalimpong Division, especially in Jaldhaka Range. Regeneration is frequently found around mother trees.
2. *Seed time*.—August. Best time of collection is the latter half of August.
  3. *Weight of seed*.—30 fruits to the lb. One pound of fruit gives 4 ounces of clean seeds. 170 seeds to the ounce.
  4. *Method of collection of seed*.—Fruits are collected from the trees by lopping branches. Fruits turn a purple colour as an indication of ripeness.
  5. *Method of treating seed*.—Fruits are heaped in the shade to rot. Pulp is then washed off by hand in water and seeds dried in the sun for a few days.
  6. *Method of seed storage*.—Seeds are not stored but sown immediately after collection.
  7. *Sowing (method and quantity of seed)*.—Seeds have been dibbled in August in lines 6' apart, 2 rows of seeds to each line, the seeds being 4" apart in each row, but results were poor. Direct sowing cannot be recommended as August is too late for direct sowing, and the young seedlings are too delicate to stand the hot weather and many die off. Direct sowing might, however, be tried in conjunction with *boga-medeloa*, the *boga-medeloa* being sown in 1' wide lines in May instead of

field crops. Again, might be tried in alternate lines with fast growing light demanders such as *gamar* which will be tall enough to give shade to the young *dude-lampate* in the first hot weather. In the nursery is dibbled 3" x 3" immediately after collection in shaded beds. Approximately 7 lbs. of seeds per *kamra* are required.

8. *Germination (time, percentage, etc.)*.—Germination good, 90 per cent. Starts in 1½ months and is complete within 9 weeks.
9. *Treatment in nursery*.—Standard method of weeding and watering. Pricking out should be done into shaded beds as soon as plants are big enough to handle.
10. *Method of transplanting*.—Transplanted with balls of earth when about 9" high in the following June immediately after lifting from the nursery beds. Winter transplanting with balls of earth in the first cold weather has proved successful. Stump planting with 2-year old seedlings has given good results. About 0.8" diameter at the collar appears to be the best size for stumps.
11. *Treatment after transplanting (weeding and cleaning)*.—If grown with *boga-medeloa* treatment should be on the lines given under paragraphs 10 and 11, *Lophopetalum fimbriatum*. It is impossible to lay down any hard and fast rule as to the intensity of thinning to be carried out in the *boga-medeloa*. The degree of light necessary for the satisfactory growth of the young plants can only be judged on the spot by frequent inspections, and Range Officers should do a thinning immediately it is seen that the plants are suffering from suppression.
12. *Tending*.—
13. *Diseases and pests*.—
14. *Rate of growth*.—Slow. The following is the rate of growth in the plantations at Sukna, Kurseong Division:—1st year—1'; 2nd year—1'—9"; 3rd year—2'—6".
15. *General remarks*.—A slow growing species and requires a certain amount of shade in its younger stages. Should not be grown pure and it is suggested that a suitable mixture would be in alternate lines with fast growing light demanders.

**Lophopetalum fimbriatum (Rakthan—Beng.).**

1. *Locality.*—Evergreen forests of the three Chittagong Divisions, on flat or slightly undulating ground on alluvial deposits along stream-beds, and in swamps. Very common in the Kasalong Range of the Chittagong Hill Tracts. Soil clayey loam. Elevation about 250'. Also found in the wet mixed forests of the plains of Northern Bengal. Regenerates itself well around mother trees.
2. *Seed time.*—In Northern Bengal seeds are ripe from the first week of August to first week of September, and in the Chittagong Divisions from the last week of July to end of August. Best time of collection in Northern Bengal is reported to be second week of August. Good seed years are annual.
3. *Weight of seed.*—Six fruits weigh one lb. and give about 2 ounces of clean seeds. 150 winged seeds to the ounce.
4. *Method of collection of seed.*—Mother trees are usually very tall with long straight boles and to collect seeds a tree may have to be felled. Trees should be felled before the fruits open or seeds will be blown away by wind at the time of felling. With small trees fruits are collected by lopping branches. Fruits may also be collected from the ground. Seeds are dark red when ripe.
5. *Method of treating seed.*—Fruits are dried in the sun until they dehisce and seeds collected. Seeds should then be spread out on mats and dried in a dry *shady* place, and should be covered with a net to prevent their being blown away.
6. *Method of seed storage.*—Seeds do not appear to keep more than two weeks. It is preferable to sow as soon after collection as possible.
7. *Sowing (method and quantity of seed).*—Direct sowing has been reported to be successful on an experimental scale in Southern Bengal where seeds ripen earlier than in Northern Bengal. This method however is not recommended, certainly for Northern Bengal, where all experiments with direct sowing have been a complete failure. In the nursery seeds are dibbled laid on their edges 3" x 3" in shaded beds as soon after collection as possible. 13 ounces of clean seeds per *kamra* are required.

8. *Germination (time, percentage, etc.).*—Germination begins in 2 weeks and is complete within 6 weeks. In Northern Bengal germination is given as 40 per cent. in shaded beds and only 3 per cent. in unshaded beds; whereas in Southern Bengal 50 per cent. in shaded and 30 per cent. in unshaded beds has been reported. Condition of growth is better in shaded beds.
9. *Treatment in nursery.*—No special treatment except standard method of weeding and watering. Manuring with leaf-mould in particular will certainly help but is not an essential condition. Should be pricked out into shaded beds as soon as they are big enough to handle.
10. *Method of transplanting.*—Is a shade bearer and cannot stand direct exposure to the sun in its younger stages. *Boga-medeloa* must therefore be put out in the same year in order to afford shade to the young plants. In Northern Bengal the *boga-medeloa* should be put out in 1' wide lines in May of the first year in place of field crops. In Southern Bengal with *taungya* crops *boga-medeloa* must be sown thickly broadcast at the time of first cleaning of the *paddy* in July-August and the blanks filled up in September when the *paddy* is reaped. If sown later than August the *boga-medeloa* will not be tall enough to afford shade to the young *rakthan* during the first hot weather. In regular plantations *boga-medeloa* is sown in 1' wide lines in May of the first year. *Rakthan* is transplanted 6' x 6' with balls of earth in their first June when about 8" high in between the lines of *boga-medeloa*. This method gives cent. per cent. success. Winter planting under shade of *boga-medeloa* with 15 months old plants also gave complete success. Stump planting with 22 months old nursery plants under the shade of *boga-medeloa* has given cent. per cent. success.
11. *Treatment after transplanting (weeding and cleaning).*—During the first rains care should be taken to lop the branches of *boga-medeloa* overtopping the lines so as to give a diffused light to the young *rakthan* plants. A thinning to single stems should be carried out in the *boga-medeloa* both before the second and third rains in order to let in more light. After thinning before the third rains the *boga-medeloa* stems should stand 4' to 6' apart in the lines. *Boga-medeloa* may be, if considered desirable, cut out before the fourth rains as the plants should be fully established by this time.



12. *Tending*.—Nothing special to note.
13. *Diseases and pests*.—Young leaves and shoots are often attacked by defoliators.
14. *Rate of growth*.—Growth slow for the first year and thereafter quite rapid. 1st year—9"; 2nd year—4'; 3rd year—7'; 4th year—10'.  
Stem analysis of a tree at Mainimukh, Chittagong Hill Tracts Division, gave a girth of 8'—3", a height of 117', and a volume of 123 c.ft. down to 8" in diameter in 128 years.
15. *General remarks*.—It is susceptible to drought during the first few years and should in Southern Bengal be confined to lower slopes and depressions on the cooler north and east aspects. It is reported from Mainimukh that this species can stand submersion under water without suffering any ill effects. Suitable for filling up wet areas in plantations. Has only been tried with *boga-medeloa* as a shade crop. It is suggested that it should be useful for putting out in alternate lines with fast growing light demanders, and experiments with this method of mixing should be carried out. In Northern Bengal is useful for putting out in areas where there are no *taungya* villagers, i.e., in regular plantations, as no field crop is required, and *boga-medeloa* can be sown in April of the first year before transplanting.

***Macaranga denticulata* (Mallata—Nep.).**

1. *Locality*.—Plains and foot-hills of Northern Bengal. It comes up naturally chiefly on land which has been cleared, forming an almost pure crop.
2. \**Seed time*.—Middle of June to the third week of July. Good seed years appear to be regular.
3. *Weight of seed*.—30,000 fruits to the lb.
4. *Method of collection of seed*.—Fruits are collected from trees by lopping branches containing the fruits. Fruits turn dark brown as an indication of ripeness.
5. *Method of treating seed*.—No treatment is necessary and seeds are not extracted from the fruits. Fruits must be dried in the sun for about 5 days. Fruits should be spread on sheets under cover out of the rain, and should be pulled out as soon as the sun comes out being taken

under cover again immediately it starts to rain. This should be carried out until the fruits are completely dry, care being taken to see that the fruits do not become wet and mildewed. This appears to be the secret of successful germination and fruits must be completely dried before sowing.

6. *Method of seed storage*.—Seeds are not stored.
7. *Sowing (method and quantity of seed)*.—Seeds should be sown thickly in lines as soon after drying as possible. 150 lbs. of fruits per acre are required for direct sowing in lines 6' apart.
8. *Germination (time, percentage, etc.)*.—Germination 50 per cent. Starts in 3 weeks and is complete within 5 weeks.
9. *Treatment in nursery*.—Not done.
10. *Method of transplanting*.—Not done.
11. *Treatment after transplanting (weeding and cleaning)*.—Not done.
12. *Tending*.—Little tending is required after the second year as growth is fast.
13. *Diseases and pests*.—None noticed.
14. *Rate of growth*.—Rate of growth in plantations at Chuna-bhati in Kalimpong foot-hills is as follows:—1st year—5' to 10'; 2nd year—10' to 15'; 3rd year—15' to 20'.
15. *General remarks*.—Is now being grown in fuel *taungyas* in the Kalimpong foot-hills. The result of mixed line sowings of *mallata* and *mandane* appears excellent and should give a very high outturn per acre.

#### **Macaranga pustulata** (*Chilley mallata*—Nep.).

1. *Locality*.—Middle hill forests of Northern Bengal, 3,000' to 6,500'. Common on landslips, rocky ground and in *jhoras*. Regenerates abundantly on landslips, open ground, and in young plantations.
2. *Seed time*.—August to November, depending on elevation. Good seed years appear to be regular.
3. *Weight of seed*.—970 clean seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the tree by lopping branches when the fruit coat turns black and looks withered. Great care must be taken to see that only ripe seed is collected. It ripens over a long period and seeds when they appear hard and black must not be considered to be ripe. Before collecting from a tree a few seeds should be cut open to see that they are properly formed.

5. *Method of treating seed.*—Fruits are spread in the sun to dry and seeds are extracted by gentle thrashing. Seeds are then dried in the sun for a few days.
6. *Method of seed storage.*—Not stored and sown immediately after collection.
7. *Sowing (method and quantity of seed).*—Direct sowing has not been tried but there is no reason why it should not be successful on level ground. Seeds are sown broadcast thinly in shaded nursery beds as soon after collection as possible.
8. *Germination (time, percentage, etc.).*—Germination is slow and takes up to 6 months to complete giving up to 40 per cent. success.
9. *Treatment in nursery.*—Usual standard method of weeding and watering. Pricking out is unnecessary if seedlings are put out in the first rains.
10. *Method of transplanting.*—Seedlings are transplanted 6'×6' with a handful of earth round the roots when about 8" high in their first rains. Seedlings become rather too big to put out in the second rains. Winter transplanting after stripping the leaves in the first cold weather gave 80 per cent. success, and is a useful method for filling in vacancies. Seedlings when 1' high have been transplanted from the forest into plantations in July with complete success.
11. *Treatment after transplanting (weeding and cleaning).*—Fairly fast growing and little cleaning will be required after the first year.
12. *Tending.*—
13. *Diseases and pests.*—None noticed yet.
14. *Rate of growth.*—Fast. Average rate of growth in plantations at Takdah, Darjeeling Division, at an elevation of 5,500', is as follows:—1st year—1'—2"; 2nd year—3'—6"; 3rd year—8'.  
Stem analysis of a tree at Merong block, Kalimpong Division, at an elevation of 5,800', gave a girth of 7', a height of 106', and a volume of 126 c.ft. down to 8" in diameter in 54 years.
15. *General remarks.*—Is fast growing, produces good box-planking timber, and is also a good firewood. In localities suited to it should be used to replace *utis*, wide paragraph 15 under *Alnus nepalensis*. It is suggested that it should not be grown pure but in alternate lines with a slow growing shade bearer.

**Machilus edulis** (*Lapche kawla*—Nep.).

1. *Locality*.—In hills from 4,000' to 8,000', best from 5,000' to 7,000'.
2. *Seed time*.—November-December to first week of January. Seeds about every three years.
3. *Weight of seed*.—Fruits are large. 13 seeds to the lb.
4. *Method of collection of seed*.—Fruits are collected from trees by lopping branches or from the ground; in the latter case the ground under mother trees should be cleaned and seed collected every day to avoid damaged seed. Care should be taken to watch for the fruiting time as both man and deer are very fond of the fruits. Fruits turn black when ripe.
5. *Method of treating seed*.—Fruits are heaped in the shade to allow the outer coat to rot. Seed is then washed, tested and dried in the sun for 2 or 3 days.
6. *Method of seed storage*.—Can be stored in a pit until February-March.
7. *Sowing (method and quantity of seed)*.—In Darjeeling Division it is sown direct in *thalis* 6' x 6' in March-April, 2 to 3 seeds to a *thali*, or dibbled in lines 6' apart the seed being 6" apart in the lines. 4 to 6 bags of seeds per acre are required for line sowing. In the Nursery is sown in February in shaded beds 3" x 3". 80 lbs. of seed are required per *kamra*.
8. *Germination (time, percentage, etc.)*.—Germination irregular. Starts in one month and continues up to 6 months giving 50 per cent. success.
9. *Treatment in nursery*.—Should be pricked out as soon as the seedlings are big enough to handle and kept in the nursery until the second rains. At lower elevations no pricking out is necessary and may be put out in July of the same year.
10. *Method of transplanting*.—Transplanted at stake 8' x 6' in the first or second rains when from 8" to 12" in height entire with a handful of earth round the roots. In Darjeeling Division seedlings have been collected from the natural forest in June when about 9" to 1' high and transplanted direct in the plantation 6' x 6' with success. These seedlings died back after transplanting and then gave out a shoot up to 4' in height after a year in the plantation.
11. *Treatment after transplanting (weeding and cleaning)*.—Frequent weedings and cleanings are necessary up to the third year as growth is slow at first.

12. *Tending*.—
13. *Diseases and pests*.—It is reported to die back on southern slopes in winter. Seed is eaten by man, and deer have been reported to dig up seed in the plantation.
14. *Rate of growth*.—Comparatively fast after the first few years. The following is the rate of growth in plantations at Takdah, Darjeeling Division, at an elevation of 5,500':—1st year—11"; 2nd year—1'—3"; 3rd year—2'; 4th year—3'. In Lopchu I plantation, Darjeeling Division, at an elevation of 5,500', a tree was found to be 48' high and 2' girth in 19 years. Stem analysis of a tree at Lingding, Darjeeling, at an elevation of 5,000', gave a girth of 6'—10", height of 100', and a volume of 143 c. ft. down to 8" in diameter in 72 years.
15. *General remarks*.—From observations it has been noted that this species grows very straight and does not branch even when comparatively isolated. It also grows to a very large size and its timber is quite valuable. It is suggested that this species might be tried on a larger scale than is at present done. Direct sowing in the hills between elevations of 4,000' to 6,000' is recommended. Care should be taken to watch for good seed years when as much seed as possible should be collected. Might be suitable for growing in alternate lines with fast growing light demanders.

***Machilus gammieana* (Lali Kawa—Nep.).**

1. *Locality*.—In the hills from 5,000' to 8,000', best between 6,000' and 7,000'.
2. *Seed time*.—November–December. Seed years occur only about every five years.
3. *Weight of seed*.—128 seeds to the lb.
4. *Method of collection of seed*.—The fruits are large and are collected from the ground. Care must be taken to watch for the fruiting time as barking deer are very fond of the fruits. Ground round the mother trees should be cleaned and fruits collected daily to avoid damaged seeds.
5. *Method of treating seed*.—Seeds are kept in a pit to rot the outer covering. They are then taken out after a month and a half to two months for cleaning and testing.

6. *Method of seed storage*.—Can be stored in a pit up till March.
7. *Sowing (method and quantity of seed)*.—Direct sowing in March-April in *thalis* 6' x 6', 1 to 2 seeds to a *thali*, is the usual practice. If sown in the nursery seeds are dibbled 3" x 3" in unshaded beds in February.
8. *Germination (time, percentage, etc.)*.—Germination begins from 4 to 6 weeks and may continue for 5 months. If seeds are tested in water before sowing 90 per cent. germination should be obtained.
9. *Treatment in nursery*.—Pricking out should be done as soon as the plants are big enough to handle and kept in the nursery until the beginning of the second rains.
10. *Method of transplanting*.—Transplanted entire 6' x 6' with or without a handful of earth round the roots during the second rains. Has been put out pure, or mixed with *kapasi*, *buk*, and *phalanit* in order to get out a larger area under this species.
11. *Treatment after transplanting (weeding and cleaning)*.—Frequent weeding and cleanings are necessary up to the third year as the growth is slow.
12. *Tending*.—
13. *Diseases and pests*.—Fruits are eaten by barking deer. Young seedlings are also liable to be browsed by barking deer up to the third year.
14. *Rate of growth*.—Growth for the first five years is slow. At Bagora, Kurseong Division, at an elevation of about 7,000', the rate of growth in plantations is as follows:—1st year—5"; 5th year—4'. Sample Plot No. 8 of Darjeeling Division at Simkona, at an elevation of 7,000', gave an average diameter of 10.5" and height of 48' in 38 years, and diameter of 4.8" and height of 41' in 25 years. Stem analysis of a tree at Lepchajagat, Darjeeling Division, at an elevation of 7,000', gave a girth of 7'—6", height of 104', and a volume of 123 c. ft. down to 8" in diameter in 74 years.
15. *General remarks*.—Best timber of the *kawlas*. Great care should be taken to watch for good seed years, when as much seed as possible should be collected. Might be suitable for growing in alternate lines with fast growing light demanders.

**Magnolia campbellii** (*Ghoge chañp*—Nep.).

1. *Locality*.—7,000' to 10,000' elevation.
2. *Seed time*.—Flowers in April, and the seed is ripe in October-November.
3. *Weight of seed*.—400 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the tree when ripe.
5. *Method of treating seed*.—Fruits are spread out in the sun to open. Seed is then removed by thrashing and washed, and afterwards dried in the sun for several days.
6. *Method of seed storage*.—May be stored in bags in a dry place for a few months.
7. *Sowing (method and quantity of seed)*.—Seeds are sown in the nursery in shaded beds in January.
8. *Germination (time, percentage, etc.)*.—Germination normally starts in 5 months but may take up to 15 months to complete, with 50 per cent. success.
9. *Treatment in nursery*.—Sown in shaded beds in January covered with  $\frac{1}{2}$ " leaf mould and pricked out 4"  $\times$  4" into unshaded beds when the plants are 6" high.
10. *Method of transplanting*.—Transplanted at the beginning of the second rains when plants are about 15" to 18" high.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—
13. *Diseases and pests*.—Does not appear to have been attacked by game or insects.
14. *Rate of growth*.—12' at the end of first year and afterwards moderately fast.
15. *General remarks*.—Not a valuable species, but may be useful for filling up blanks in plantations at higher elevations where the choice of species is limited.

**Meliosma thomsoni** (*Sindure dabdabe*—Nep.).

1. *Locality*.—Middle hill forests. Commonest about 6,000'.
2. *Seed time*.—September.
3. *Weight of seed*.—90 seeds to the ounce.
4. *Method of collection of seed*.—Fruits when they turn red are collected from the tree by lopping branches.

5. *Method of treating seed*.—Fruits are laid in a heap to rot and seeds are then removed by hand and washed. Seeds are dried in the sun for a few days.
6. *Method of seed storage*.—Not stored and seeds are sown as soon after collection as possible.
7. *Sowing (method and quantity of seed)*.—Seeds are sown broadcast immediately after collection in shaded nursery beds.
8. *Germination (time, percentage, etc.)*.—Germination starts in about 5 weeks and is complete within 4 months giving 40 per cent. success.
9. *Treatment in nursery*.—Standard method of weeding and watering. Seedlings should be pricked out into shaded beds as soon as they are big enough to handle.
10. *Method of transplanting*.—Transplanted 6' x 6' entire with a handful of earth round the roots in the first rains when about 7" high. Winter transplanting of the seedlings in the first cold weather after stripping the leaves gave cent. per cent. success.
11. *Treatment after transplanting (weeding and cleaning)*.—Usual weeding and cleaning.
12. *Tending*.—
13. *Diseases and pests*.—None noticed yet.
14. *Rate of growth*.—The rate of growth at an elevation of 5,500' is 2' in first year.
15. *General remarks*.—This species when sawn up is often mixed with that of *toon* by contractors.

**Mesua ferrea** (*Nagesicar*—Beng., *Nagesuri*—Nep.).

1. *Locality*.—Evergreen forests of the Chittagong Hill Tracts mainly in the Kasalong Range, and sporadically in the Chittagong district on cool and shady aspects. Soil clayey loam to loam, elevation up to 200'. Also occurs sparingly in the plains forests of Northern Bengal chiefly between Neora and Jaldhaka rivers in the Duars. Regeneration is good near mother trees.
2. *Seed time*.—Middle of July to beginning of September. In Southern Bengal the best time of collection is at the end of August.
3. *Weight of seed*.—130 seeds to the lb.
4. *Method of collection of seed*.—Mature fruits are collected from the tree or from the ground.



5. *Method of treating seed*.—Fruits are spread out in the sun until they dehisce. Seeds are then collected and dried under shade.
6. *Method of seed storage*.—Seeds will keep for a year. They can be stored in gunny bags, and should be spread out occasionally under shade and examined for insect attack.
7. *Sowing (method and quantity of seed)*.—Direct sowing in lines 6' apart, 2 rows of seeds to each line, has been successful in the Silvicultural Garden at Hazarikhil, Chittagong Division. Experiments have shown that this species is extremely sensitive to drought especially during the first two years. *Boga-medeloa* should be sown in between the lines exactly as described under paragraph 7, *Dichopsis polyantha*. In the nursery seeds are dibbled on their edges 3" x 3" in shaded beds to a depth equal to the thickness of the smallest diameter of the seed and are covered with a thin layer of earth. Seven pounds of seed per *kamra* will suffice. Seeds should be sown both direct in the plantation and in the nursery as soon after collection as possible.
8. *Germination (time, percentage, etc.)*.—Germination is excellent, begins in 10 days and is complete within about 2 months. Ninety to 95 per cent. germination has been recorded both in shaded and unshaded beds and 75 per cent. with direct sowing under shade of *boga-medeloa*. Condition of growth is slightly better in the shaded bed than in the open.
9. *Treatment in nursery*.—Pricking out 4" x 4" should be done in shaded beds as soon as plants are big enough to handle. No special treatment is required except the standard method of weeding and watering. Manuring with leaf mould will help, but is not essential.
10. *Method of transplanting*.—Transplanting 6' x 6' with balls of earth in the second rains has been done on a small scale with success. Experiments are now being carried out to see if stump-planting will be successful. *Boga-medeloa* should be sown in between the lines of *thalis* in the first year.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—*Boga-medeloa* should be tended as laid down under paragraph 12, *Dichopsis polyantha*.

13. *Diseases and pests.*—Rats damage seedlings in the nursery. In the Khumani forest, Kalimpong Division, trees were found to have been attacked by a fungus, but the attack was very limited.
14. *Rate of growth.*—Slow. 1st year—1'; 2nd year—2'—6"; 3rd year—3'—6".
15. *General remarks.*—Has only been tried in the Silvicultural Nursery and Garden at Hazarikhil on a small scale. Cleaning of lines should not be done during the cold and hot weathers and weeds should be left to shade the soil. It should only be put out on lower slopes and bottom of ridges on cool north and east aspects. Direct sowing in lines 6' apart, 2 rows of seeds in each line, appears to be the best method and is recommended in preference to transplanting.  
This species might be useful for undersowing or planting as from observations in the natural forest at Mainimukh it appears that young regeneration can persist under shade for many years. Might also be tried in alternate line mixtures with fast growing light demanders. Is a useful species for sowing up blanks in the current year's plantation as it seeds late.

**Michelia champaca** (Chaiñp—Nep.).

1. *Locality.*—Plains forests of Northern Bengal up to 3,000'. Grows well in *sal* forests. Also found scattered in the evergreen forests of the three Chittagong Divisions. *Will not stand water-logging* and prefers a well-drained soil as is required for *sal*. In fact appears to be even more sensitive than *sal* to water-logging, and should therefore only be put out on the highest ground. Good regeneration is often to be found around mother trees.
2. *Seed time.*—August-September. It is reported that seeds collected early in August germinate badly, the best time to collect being from the end of August to the beginning of September. It is interesting to note that a tree at Matelli (Jalpaiguri Division), and trees at the Range Office, Baraiyadhala (Chittagong Division), flower throughout the year. Seeds have been collected at Matelli in March, and at Baraiyadhala in March-April and August-September, and germination with each of these collections has been successful.
3. *Weight of seed.*—17 to 20 lbs. of fruits give 1 lb. of clean seeds. 406 seeds per ounce.

4. *Method of collection of seed.*—Mature trees are usually tall and have to be climbed and small branches containing clusters of fruits lopped. Fruits, when ripe, turn greyish brown in colour and start to dehisce exposing the red pulp. Another indication of ripeness is when the parrots begin to feed on the fruits and the fallen seeds appear red. Seeds should not be collected from the ground as they are usually found to be insect-attacked.
5. *Method of treating seed.*—Fruits are heaped in the shade for 2 or 3 days until they open. Seeds are then removed by gentle thrashing. The red pulp is washed off in water. Seeds are spread under shade to dry, and never in the sun. At the time of washing, water test should be carried out and bad seeds rejected.
6. *Method of seed storage.*—Seeds cannot be stored and should be sown as soon after collection as possible. It is reported that after 7 days 10 per cent. of the seeds, and after a fortnight 40 per cent., failed to stand the water test.
7. *Sowing (method and quantity of seed).*—Seeds too late for direct sowing and is therefore sown in nursery beds under shade, either broadcast or in drills, 3" to 4" apart, with a small quantity of earth sprinkled over the seed. Thatch grass or brushwood may sometimes be spread over the beds to hasten germination. Seeds should be mixed with red lead, before sowing to prevent attack by red ants and rats. Approximately 2½ lbs. of clean seeds should be sown in the nursery to provide sufficient plants to plant up an acre, 6' × 6'. Experiments have been carried out with direct sowing in *thalis*, 3 or 4 seeds to a *thali*, with seeds collected early, results so far are not promising and direct sowing is not recommended.
8. *Germination (time, percentage, etc.).*—Germination starts in 10 to 14 days, and may continue up to several months. Germination is usually good, from 70 to 80 per cent.
9. *Treatment in nursery.*—This species grows very quickly in the nursery and so, often becomes difficult to transplant. It is therefore necessary to retard the growth as much as possible. Beds should not be manured heavily and in fact in some Ranges no manure is used at all. Watering may be done fairly frequently up to the time of germination but afterwards the beds

should only be kept just moist and watering once a week is usually sufficient. Shades may be removed with advantage when seedlings are established as they tend to draw the plants up. In some Ranges, sowing is done thinly in the nursery beds to avoid pricking out. The writer is of the opinion that pricking out should always be done, 4' x 4" or 6" x 6" as it helps to check the height growth and results in a bushy root-system, the latter being a most important point as this species is very sensitive to transplanting. In fact it is suggested that pricking out might be done twice. An experiment in Kursong Division showed that plants pricked out once were 1'—3" high, and those pricked twice only 8" high in 6 months.

10. *Method of transplanting.*—Transplanting is done in June at the break of rains. The seedlings are sensitive and great care must be taken not to damage the roots. Planting holes should be deep and the roots must not be doubled up. In some Ranges transplanting is done with balls of earth and in others with only a handful of earth round the roots. There is no doubt there are fewer casualties with ball planting, but success mainly depends on the weather; provided the day is cloudy and the ground wet entire planting with a handful of earth is successful. Winter planting of 16 months' old plants after stripping the leaves has not proved a success; whereas winter transplanting with balls of earth in December-January with seedlings about 4" high taken from the pricking out beds from seeds sown in August has been very successful, and is an extremely useful method for filling up blanks in the first cold weather. The practice is to shade these young plants on the southern side by fixing up a couple of crossed cotton stalks about 1'—6" long and placing a handful of *paddy* stalks against them. This prevents the young plants being killed during the hot weather at the end of February to beginning of April and costs nothing, the villagers erecting them at the time of winter cleaning. The results on a large scale under this method have given cent. per cent. success. Root and shoot cuttings of 2-year old nursery plants have been done with success, but as each stump gives forth numerous shoots which have to be pruned, this method is not recommended.
11. *Treatment after transplanting (weeding and cleaning).*—*Thalis* should be tilled up once or twice during the rains, as the species is very sensitive to water-logging,

and if water is allowed to accumulate in the *thali* the plants die off. From observations it has been noticed that the majority of casualties, after plants appear to be established, is due to this.

12. *Tending*.—*Chañp* closes up within 2 or 3 years, and little weeding or climber pulling is required after this age. Grows quickly and thinning is usually required in well-stocked plantations in the fifth year. A heavy thinning may be done as plants respond very quickly. There is no danger of forking as even isolated plants clean themselves of branches, and there is little fear of damage by climbers as these have usually been kept under by the dense shade of the past 3 years. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests*.—All *chañp* plantations of Northern Bengal have now been more or less severely attacked by the pest, *Urostylis punctigera*. A small number of these insects pass the cold and hot weathers in an adult stage on the young *chañp*. As soon as the first showers start in April-May, these insects start to breed and by July-August adults, imagoes of all sizes and eggs are found on the tree at the same time. These cluster round the axils of branches and stem starting from the crown, and suck the juice, thus arresting the flow of the sap. Leaves begin to wither and branches fall off. The pest is not selective, and once it is noticed usually all the trees are found to be attacked. Has been known to kill off plants up to 4 years of age in one season's attack, but more often trees are attacked year after year killing back the leading shoot annually thus gradually weakening the tree until it dies. Another pest (identified as *Thysanoptera*) which causes the browning and dying off of leaves and twigs, has been noticed in some plantations but it appears to do little damage, and the plants recover. Deer damage the bark and browse the young plants. Is easily damaged by fire and so should not be inter-mixed in *sal* plantations that may be burnt. Seed is damaged by mice. Parrots eat the seed on the tree as soon as it ripens.
14. *Rate of growth*.—Rapid. The following is the average rate of growth in plantations:—1st year—3'—10"; 2nd year—8'; 3rd year—12'—3"; 4th year—19'—9"; 5th year—23'—6".

Sample Plot No. 11 at Rajabhatkhawa in Buxa Division, at plains level, gave an average diameter of 5.5" and height of 47' in 8 years. Stem analysis of a tree at Sanghai Road in Rajabhatkhawa Range, Buxa Division, at plains level, gave a girth of 9'-1", height of 120', and a volume of 225 c.ft. down to 8" diameter in 60 years.

15. *General remarks*.—Observations up to date indicate that it will not be possible to find feasible means for bringing the pest, *Urostylis punctigera*, under control. The timber of this species is valuable and it would not be advisable to give up growing it altogether. It should therefore be grown only in mixtures, and it is suggested that it would be best to mix it sparsely in the groups of lines method with other species of roughly the same rate of growth. In years when there is a shortage of plants it has been mixed in alternate *thalis* with *kainjal* in order to plant up a larger area. This mixture so far has proved quite successful and the *chañp* as a rule gradually keeps ahead of the *kainjal*.

***Michelia excelsa* (Chañp—Nep.).**

1. *Locality*.—Found at elevations between 5,000' to 9,000' grows best at 6,000' to 7,500'. Prefers a rich clayey loam and well-drained soil. Regenerates itself naturally in places where it falls on a good rich soil, and the under-growth is not dense.
2. *Seed time*.—November-December.
3. *Weight of seed*.—25 lbs. of fruits give approximately 1 lb. of clean seed. 300 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from the trees by lopping branches when fallen seeds appear red. Fruits should not be collected from the ground, as they are usually insect-attacked. Seeds must be collected from mature trees as those from younger ones are reported to give poor germination.
5. *Method of treating seed*.—Fruits are dried in the shade until they open and seeds are removed by gentle thrashing. The pulp is then washed off in water and the seed dried in the sun for 2 or 3 days. Water test for seeds should be carried out at the time of washing.

6. *Method of seed storage*.—Seeds can be stored for a couple of months in a dry ventilated shed after mixing with ashes. Can also be stored in a pit after mixing the seed with dry earth and ash, and the pit filled up with about 2' of earth. Great care must be taken to see that the ground is dry. Neglect of this point may cause a heavy loss.
7. *Sowing (method and quantity of seed)*.—Seeds are sown in shaded nursery beds, about 4 lbs. of seeds per *kamra* will suffice. Brushwood and straw is sometimes spread over the bed to hasten germination and is removed as soon as germination starts. Seeds should be mixed with red lead to prevent damage by rats. Some Ranges sow immediately after collection and others in February and March. It is reported that if seeds are sown in December it is too cold to germinate and they only lie dormant until February-March. Seeds are either sown broadcast or in drills 3" apart.
8. *Germination (time, percentage, etc.)*.—Germination is slow and starts in 4 weeks and may continue up to 2½ months. Germination is usually poor from 25 to 40 per cent. It is reported from the Kurseong Division that better results are obtained if seeds are sown in a completely new nursery site such as can be made in a clear-felling coupe.
9. *Treatment in nursery*.—Nursery beds should be shaded and excessive watering should be avoided. Seedlings should be pricked out into shaded beds 3"×3" when their third leaf appears and they are about 2" to 3" high. Shades should be removed from pricking out beds in the following April-May as soon as the danger from hail is over.
10. *Method of transplanting*.—This species should *never* be grown pure and is transplanted either 6' apart in alternate lines with fast growing light demanders such as *birch*, *utis*, etc., or in quincunx (the centre plant) with species such as *phalañt*, *kapasi*, etc., in June or July of their second rains entire with or without a handful of earth round the roots when they are from 12" to 15" high. Some Range Officers transplant with balls of earth but this does not appear necessary. Plants are sometimes kept in the nursery until June of the third rains especially at higher elevations. Transplanting of natural seedlings from the forest when 4" to 6" high is now done in most Divisions with

success, but some Range Officers report that such seedlings tend to become very branchy. In some cases, natural seedlings are pricked out and kept for a year in the nursery so as to prevent loss due to sudden exposure. Winter transplanting of 2-year old seedlings after stripping the leaves can be done with 90 per cent. success.

11. *Treatment after transplanting (weeding and cleaning).*—Care should be taken when weeding and cleaning to see that the young *chañp* plants are allowed to grow up in an intimate mixture with other species, no coppice or species that have come in naturally should therefore be cut out unless they are actually suppressing the growth of the *chañp*.
12. *Tending.*—When thinning care must be taken to see that *chañp*, being the most valuable species, is not allowed to become pure with consequent retarded growth, and after thinning each *chañp* plant must be left intimately surrounded by other species. In the existing pure plantations every effort must be made to encourage the introduction of miscellaneous species and the cutting of fodder should not be allowed in such plantations.
13. *Diseases and pests.*—Seeds and young plants in the nursery are damaged by rats and squirrels. Deer browse shoots in young plantations. Suffers severely from frost damage at higher elevations. The larva of a moth, a species of *Phasus*, bores into the stem of young *chañp*.
14. *Rate of growth.*—Fairly fast for the first five years and then slows down. At Poobong, Darjeeling Division, at an elevation of 6,500', the average rate of growth in plantations is as follows:—1st year—1'—2"; 2nd year—3'—2"; 3rd year—5'—5"; 4th year—6'—10"; 5th year—8'—7".  
Sample plot No. 23 of Darjeeling Division at Passam-bing, at an elevation of 7,500', gave an average diameter of 11.0" and height of 66' in 40 years. Stem analysis of a tree at Upper Babukhola, Kurseong Division, at an elevation of 7,000', gave a girth of 7'—0", height of 80', and volume of 96.8 c.ft. down to 8" diameter in 118 years.
15. *General remarks.*—Pure *chañp* plantations are silviculturally unsound. Trees look unhealthy, covered with moss, more often than not badly forked, and growth is extremely slow. On the other hand *chañp* raised in mixtures in Manson's Coupes look extremely healthy



with good height growth and little or no forking. It looks its best when in intimate mixtures with such species as *phalañt*, *kapasi*, *kawlas*, etc. *Chañp* will therefore not be grown pure in future and will be mixed in alternate lines with fast growing light demanders, and at the same time the object should be to allow coppice regrowth, and any species that come in naturally, to form an intimate mixture with the *chañp* plants. Quincunx planting (*chañp* being in centre) with such species as *phalañt*, *kapasi*, *kawlas*, etc., is also suggested, as a sound method of mixing. At higher elevations *chañp* should always be mixed with such species as *utis*, and *birch* as a protection against frost damage.

***Michelia lanuginosa* (*Phusre chañp*—Nep.).**

1. *Locality*.—Middle hill forests of northern Bengal from 4,500' to 7,000'. Good regeneration is often to be found around mother trees.
2. *Seed time*.—November-December. Best time of collection is the first week of December at lower elevations, and the latter part of December at higher elevations. Good seed years are fairly regular.
3. *Weight of seed*.—207 clean seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from trees by lopping branches. Fruits turn reddish-orange as an indication of ripeness.
5. *Method of treating seed*.—Fruits are dried in the sun for a few days until they open. Seeds are extracted by hand and the pulp washed off in water. Clean seed is then dried in the sun for a few days.
6. *Method of seed storage*.—Seeds cannot be stored and should be sown as soon after collection as possible.
7. *Sowing (method and quantity of seed)*.—Seeds are sown in the nursery either broadcast or in drills in shaded beds as soon after collection as possible. Five pounds of clean seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.)*.—Germination starts in about 4 months and is complete within 6 months giving up to 60 per cent. success.

9. *Treatment in nursery*.—After sowing in the nursery brush-wood or grass is spread over the beds to hasten germination. Usual standard method of weeding and watering. Pricked out 3" x 3" into shaded nursery beds in July when about 3" to 4" high.
10. *Method of transplanting*.—At lower elevations seedlings have been transplanted in their first August when about 3" to 4" high but these are considered rather too small to transplant. Usually transplanted 6' apart in the line in alternate lines 6' apart with fast growing light demanders. Transplanting is done with balls of earth or with a handful of earth round the roots in June of the second rains when about 1'—6" high. Very easy to transplant and cent. per cent. success should be obtained. Transplanting should be done immediately on raising from the bed. Seedlings from the natural forest have been transplanted into plantations in July when about 4" high with complete success.
11. *Treatment after transplanting (weeding and cleaning)*.—Usual cleaning and weeding. Is fast growing and little cleaning should be required after the second year.
12. *Tending*.—
13. *Diseases and pests*.—None noticed yet.
14. *Rate of growth*.—Comparatively fast, much faster than *Michelia excelsa*. The following is the rate of growth in the plantations at Algarah, Pankhasari Range, Kalimpong Division, at an elevation of 5,600':—1st year—1'; 2nd year—3'; 3rd year—7'; 4th year—11'; 5th year—20'. A 15-year old plant gave a height of 50' and a breast-height girth of 2'—4". Stem analysis of a tree at Dumsong, Kalimpong Division, at an elevation of 5,400', gave a girth of 6'—8", a height of 104', and a volume of 87 c. ft. down to 8" diameter in 92 years.
15. *General remarks*.—This species produces a fairly useful timber and gives an excellent fuel and charcoal. Besides being fast growing it can stand a certain amount of shade, and excellent plantations have been raised in Kalimpong Division in alternate lines with such species as *uts* and *birch*. This mixture will probably give a higher outturn per acre of timber and fuel than any other mixture at present put out. This mixture should be grown on a larger scale in all hill divisions especially where there is a demand for fuel

**Morus indica** (*Sanu kimbu*—Nep., *Tut*—Beng.).

1. *Locality*.—Plains, foot-hills and lower-hills of Northern Bengal, up to 4,000'. Prefers a light sandy soil. Natural regeneration is fairly common.
2. *Seed time*.—March-April. Best time of collection is first half of April. Good seed years appear to be annual.
3. *Weight of seed*.—Eight pounds of fruits produce 3 ounces of clean seeds. 14,350 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from trees by hand. Should never be collected from the ground as owing to its tasteful juice, seeds are more often than not insect attacked. Fruits turn purple as an indication of ripeness.
5. *Method of treating seed*.—Fruits are heaped in the shade to rot and then the pulp is removed by washing in water and seeds are dried in the sun for a few days. Also fruits may be pressed in a cloth and juice removed. Pulp is then dried in the sun for 3 or 4 days and when completely dry, rubbed by hand and seeds removed.
6. *Method of seed storage*.—Seeds may be stored in a well ventilated shed until ready for sowing in May.
7. *Sowing (method and quantity of seed)*.—Seeds are usually sown direct fairly thick in lines 6' apart in May. If sown in the nursery is sown thinly broadcast in shaded beds as soon after collection as possible. Four ounces of seeds per *kamra* will suffice. When sowing either broadcast or in the nursery seeds should be covered with a light layer of earth.
8. *Germination (time, percentage, etc.)*.—Germinates in 3 weeks and is complete within 3 months giving 40 per cent. success.
9. *Treatment in nursery*.—Usual standard method of weeding and watering. Pricking out is not necessary as transplants are put out the same year. Shades should be removed some time before transplanting.
10. *Method of transplanting*.—Transplanted successfully with balls of earth or a handful of earth round the roots in the first July when about 6" high. Winter transplanting in the first cold weather when 1' high gave cent. per cent. success. Stump planting with 15 month old seedlings in the second rains is completely successful. About 0.8" diameter at the collar is the most suitable size for stumps. Branch cuttings have

given cent. per cent. success and their rate of growth in the first year far exceeds that under any other method. For this reason this method is recommended for raising this species in areas where cuttings are available near by in the natural forest. Cuttings of branches 1' long and from  $\frac{1}{4}$ " to 1" diameter are planted at a slant 10" below and 2" above ground, and give an average height of 7' and maximum of 12' at the end of the first rains. Cuttings are put out in lines 6' apart and 1' to 2' apart in the line. When planting cuttings care should be taken that not more than 2" is left above ground, as observations show the longer the stem left above ground the more the number of shoots that will come up, necessitating heavy pruning.

11. *Treatment after transplanting (weeding and cleaning).*—Experiments have shown that a slightly better germination per cent. is obtained in direct sowing when carried out in conjunction with shade of *boga-medeloa*, but the difference is not sufficient to justify the use of a cover crop. Moreover, experiments show that a low shade crop such as *boga-medeloa* definitely retards its rate of growth. Shade crops are therefore not recommended with this species.
12. *Tending.*—
13. *Diseases and pests.*—None noticed.
14. *Rate of growth.*—Fast, especially from branch cuttings. Rate of growth from direct sowing at Sukna in Kurseong Division is as follows;—1st year—3'; 2nd year—6'. Branch cuttings at Katambari, Jalpaiguri Division, gave an average height of 7' in one year.
15. *General remarks.*—Not much is known about the silviculture of this species, but observations in the natural forest show that whereas the shade given by a low cover such as *boga-medeloa* is definitely harmful, on the other hand that given by a light canopied fast growing species would appear to be exactly what is required. Experiments should be carried out to grow it in alternate lines with such species as *Evodia meliaefolia*, *sissoo*, that give a very light canopy. Specimens of this timber have been sent to Dehra Dun for report as to its utility for tennis rackets, hockey sticks, etc. If found suitable should be put out on a large scale on light sandy soil such as is found near the Mechi and Rehti rivers, in parts of the Kalimpong foot-hills, and the Raidak and Bholka forests of the plains of Northern Bengal.

**Morus laevigata (Kimbu—Nep.).**

1. *Locality.*—Foot-hills up to 5,000' and sporadically on silt in the plains. Has not done well in the plains, best in the hills from 2,000' to 4,000'. Regeneration is seldom found in the natural forest.
2. *Seed time.*—First half of April to second half of May. Seed years are irregular.
3. *Weight of seed.*—13,000 seeds to the ounce.
4. *Method of collection of seed.*—Fruits should be collected from the trees known to be fertile, as apparently all trees are not fertile. Fruits should be collected by lopping small branches containing clusters of fruits.
5. *Method of treating seed.*—Fruits are heaped in the shade and allowed to rot for 5 to 6 days. Fruits are then washed in water and the small seeds are separated by hand and dried in the sun.
6. *Method of seed storage.*—Can be kept in a dry ventilated shed until May-June.
7. *Sowing (method and quantity of seed).*—Observations show that pure plantations are silviculturally unsound. In the plains and foothills the method now is to mix a handful of seed in a bag of mixed *chikrase* and *panisaj* seeds. The *kimbu* comes up widely scattered in the lines and looks extremely healthy, and being a faster grower than the other two species, is kept clean by them, with the result that stems grow straight with few branches. Seed is minute and direct sowing is impossible on slopes. At higher elevations seeds are sown broadcast in shaded nursery beds as soon after collection as possible.
8. *Germination (time, percentage, etc.).*—Good, about 60 per cent. success within 5 weeks.
9. *Treatment in nursery.*—Usual method of weeding and watering. At lower elevations seeds are pricked out 4" x 4" into shaded beds as soon as they are big enough to handle, and if sowing has been done immediately after collection plants should be big enough to put out in August of the first rains. At higher elevations plants will have to be kept until the second rains.
10. *Method of transplanting.*—At lower elevations plants are transplanted 6' x 6' entire with a handful of earth round the roots in August of the first rains. Winter transplanting can be done successfully in the first cold

weather. Stump planting in the second rains is also very successful. At higher elevations seedlings are transplanted 6' x 6' with balls of earth in the second rains. At an elevation of 5,000' winter transplanting with balls of earth in the first cold weather gave cent. per cent. success. This species has a fibrous root and is easy to transplant.

11. *Treatment after transplanting (weeding and cleaning).*—Grows fairly quickly, so little cleaning is required after the second year.
12. *Tending.*—Requires thinning in the fifth year in well-stocked plantations.
13. *Diseases and pests.*—Very susceptible to damage by game. Young trees 5 years old have been often found attacked by the larva of longicorn beetle.
14. *Rate of growth.*—Fast growing. The average rate of growth in plantations in the Tista Valley Range, Darjeeling, is as follows:—1st year—7'; 2nd year—9'; 3rd year—12'; 4th year—15'; 5th year—18'. At an elevation of 5,500'—1st year—1'; 2nd year—2'—9".
15. *General remarks.*—

***Phoebe attenuata* (Angare—Nep.).**

1. *Locality.*—Lower hill forests of Northern Bengal upto 4,000'. Common east of the Tista, especially in the Kalimpong foothills. Is chiefly found in moist and shaded places. Regenerates itself easily under shade.
2. *Seed time.*—July. Best time of collection is third week of July. Seed years are irregular.
3. *Weight of seed.*—700 fruits to the lb. 65 clean seeds to the ounce. Three and half pounds of fruits produce 1 lb. of clean seeds.
4. *Method of collection of seed.*—Fruits are collected from the trees by lopping branches. Fruits turn black as an indication of ripeness.
5. *Method of treating seed.*—The fruits are buried in a pit for 2 or 3 days in order to rot the pulp. The pulp is then washed off by hand in water, and seeds are dried in the shade for a few days.
6. *Method of seed storage.*—Seeds are not stored and are sown as soon as after collection as possible.

7. *Sowing (method and quantity of seed).*—Is a shade bearer and cannot stand direct exposure to the sun in its younger stages and must be raised in conjunction with shade, either with *boga-medeloa* or in alternate lines with a fast growing light demander, the latter method being preferred. If sown direct with *boga-medeloa*, the *boga-medeloa* should be sown in 1' wide lines 6' apart in May-June of the same year in order to afford shade to the young plants. *Angari* is then dibbled midway between lines of *boga-medeloa*, 2 rows of seeds to each line, the seeds being 4"—6" apart in the row. Direct sowing has not so far proved satisfactory and transplanting is the method recommended for raising this species. Seeds must be sown immediately after collection. In the nursery is dibbled 3" x 3" in shaded beds immediately after collection. Two pounds of seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.).*—Germination gives 65 per cent. in shaded beds and only about 5 per cent. in unshaded beds. Starts in a month and is complete within 4 months.
9. *Treatment in nursery.*—Standard method of weeding and watering. Pricking out should be done into shaded beds as soon as plants are big enough to handle.
10. *Method of transplanting.*—*Boga-medeloa* must be put out in 1' wide lines in May of the same year as transplanting is done. *Angari* is then transplanted 6' x 6' with balls of earth in June of the second rains when about 8" high. Winter transplanting between lines of *boga-medeloa* in December of the first year has given 90 per cent. success. Experiments with stump planting have so far been a failure. If put out in alternate line mixtures with fast growing light demanders is transplanted 6' apart in its line, the other species forming the mixture having been sown earlier on in the same year.
11. *Treatment after transplanting (weeding and cleaning).*—Although *angari* requires a fairly heavy shade during the first year, experiments have shown that a too heavy shade from the second year onwards definitely retards its rate of growth. During the first rains care should be taken to lop the branches of *boga-medeloa* overtopping the lines so as to give a diffused light to the *angari*. A thinning to single stems 3' to 4' apart before the second rains, and to 6' apart before

the third rains appears to be the most satisfactory treatment. *Boga-medeloa* may be, if considered advisable, cut out before the fourth rains as the plants should be fully established by that time.

12. *Tending*.—
13. *Diseases and pests*.—Nothing noticed up to date.
14. *Rate of growth*.—Comparatively slow. Rate of growth in plantations at Sukna, Kurseong Division, is as follows:—1st year—4"; 2nd year—1'; 3rd year—3'; 4th year—4'.
15. *General remarks*.—This species should not be put out pure and it is recommended that it should be put out in alternate lines with fast growing light demanders. Small scale experiments in alternate line mixtures with *panisaj* in the Kalimpong Division show distinct promise.

***Phoebe hainesiana* (Bonsum—Assam.).**

1. *Locality*.—Found chiefly in Upper Assam in the riverain tracts and plains just above flood level; in forests of a wet-mixed and evergreen type on the heavier soils varying from sandy loam to clay. Is also found as high as 5,000' in the Naga hills, on banks of rivers where it grows to a large size. Is a shade-bearer and young seedlings are killed off by prolonged exposure to the sun in the hot weather. Is reported to be found in the Tista Valley Range, Darjeeling Division, and also in the Merong Block, Kalimpong Division.
2. *Seed time*.—September-October; best time to collect seed is the end of October.
3. *Weight of seed*.—450 clean seeds to the lb.
4. *Method of collection of seed*.—Fruits are not usually collected until they have been on the ground at least a month, as by that time bad seeds will crumble up and good ones can be sorted out. There is no fear of the seed germinating as these seeds have usually a resting period of over 2 months.
5. *Method of treating seed*.—In Assam fruits are spread out in a dry cool place for about 14 days to let the fleshy outer covering dry up. From observations under paragraph 7, it would appear fruits should be heaped under shade to allow the pulp to rot, seeds then washed and dried under shade.



6. *Method of seed storage*.—Seeds are usually received from Assam at the end of September to the beginning of October and sown immediately on receipt. Assam reports that after 3 months germination per cent. was reduced to under one-third. At Sukna seeds were kept in a well-ventilated shed with a view to experimenting with direct sowing; seeds were examined in April and none were found fit for sowing.
7. *Sowing (method and quantity of seed)*.—Sown in shaded beds by dibbling 4" x 4" immediately on receipt. Before sowing water test should be carried out. Pulp should be washed off before sowing. An experiment showed that clean seed started germinating after 7 weeks and uncleaned after 3½ months. Germination per cent. of the clean seed was 80 and the uncleaned 52.
8. *Germination (time, percentage, etc.)*.—Germination commences after 7 weeks and continues up to 5 months. Germination per cent. good, up to 80 per cent.
9. *Treatment in nursery*.—No special treatment except the standard method of watering and weeding. Shades should never be removed from the beds. Pricking out is not necessary.
10. *Method of transplanting*.—Is a shade bearer and cannot stand direct exposure in its younger stages. *Boga-medeloa* must therefore be put out in the same year in order to afford shade to the young plants. *Boga-medeloa* must be put out in 1' wide lines in May of the first year in place of field crops. *Bonsum* is transplanted with balls of earth in June when 8 months old and about 9" high in between the lines of *boga-medeloa*. This method has given 90 per cent. success. Winter transplanting with balls of earth in the first cold weather in between the lines of *boga-medeloa* was completely successful. Stump planting of seedlings in the second rains in between the lines of *boga-medeloa* gave 80 per cent. success.
11. *Treatment after transplanting (weeding and cleaning)*.—During the first rains care should be taken to lop the branches overtopping the lines so as to give diffused light to the young *bonsum* plants. A thinning to single stems should be carried out in the *boga-medeloa* both before the second and third rains in order to let in more light. After thinning before the third rains the *boga-medeloa* stems should stand 4' to 6' apart in the lines. *Boga-medeloa* may be, if considered desirable, cut out before the fourth rains as the plants should be fully established by this time.

12. *Tending*.—It appears that the seedlings cannot stand suppression from short grass and weeds, which must be cleaned from the *thalis* immediately they begin to overtop the seedlings.
13. *Diseases and pests*.—The fruits are often penetrated by small larva. Seeds are eaten in the nursery by porcupines and rats.
14. *Rate of growth*.—Fair. The following is the rate of growth in plantations at Sukna, Kurseong Division, at an elevation of 500':—1st year—7"; 2nd year—1'—8"; 3rd year—4'—8"; 4th year—9'; 6th year—13'.
15. *General remarks*.—It appears to be a useful species for putting out on soils a little too heavy and damp for *sal*. In Northern Bengal is very useful for putting out in areas where there are no *taungya* villagers, i.e., in *regular* plantations, as no field-crop is required, and *boga-medeloa* can be sown in April before transplanting. The Forest Economist reports from Dehra Dun that the timber of this species is in most respects superior to *teak*. Has only been tried with *boga-medeloa* as a shade crop. It is suggested that it should be useful for putting out in alternate lines with fast growing light demanders and experiments with this method of mixing should be carried out.

***Pinus longifolia* (Chir—Hind.).**

1. *Locality*.—Badamtam Block, Darjeeling Division, and in Sikkim. It grows well from 1,000' to 3,000' elevation. Also put out as an exotic at Kundong, Kurseong Division.
2. *Seed time*.—April-June. Best time of collection is latter part of April.
3. *Weight of seed*.—54 lbs. of cones give 1½ lbs. of clean seeds. 250 seeds per ounce.
4. *Method of collection of seed*.—Cones are collected from the trees and dried in the sun. The scales then open and seeds are shaken out.
5. *Method of treating seed*.—No special treatment required.
6. *Method of seed storage*.—Seeds can be stored in a well-ventilated room until the following April.

7. *Sowing (method and quantity of seed).*—Seeds are usually sown direct broadcast in lines 6' apart. If sown in the nursery, are sown broadcast in shaded beds and covered with a thin layer of leaf mould. 1½ lbs. of seeds per *kamra* will suffice. Should be sown as soon after collection as possible in order to get plants big enough to put out in the first rains.
8. *Germination (time, percentage, etc.).*—Germination is good, up to 90 per cent. and occurs within 8 to 10 days.
9. *Treatment in nursery.*—The seedlings are pricked out 3" × 3" in the middle of June into shaded beds.
10. *Method of transplanting.*—When about 4" to 6" in height seedlings are transplanted in August of the 1st year 6' × 6' in *thalis*.
11. *Treatment after transplanting (weeding and cleaning).*—This species appears to do better with a little shade when young. For this reason when cleaning, the soil should not be exposed and weeds that are not actually interfering with the plants should be left to afford shade.
12. *Tending.*—
13. *Diseases and pests.*—
14. *Rate of growth.*—
15. *General remarks.*—

***Podocarpus neriifolia* (Banspatta—Chitg.).**

1. *Locality.*—In Northern Bengal the tree is rare. Has been found in the wet mixed forests of *Dalka* in the plains of Kurseong Division and up to a height of 5,000'. Groups of trees are to be found in Sivoke hills, Mongpong and Lopchu. Is to be found scattered in the evergreen forests of the Kasalong Reserve, Chittagong Hill Tracts Division, up to 1,000' elevation both on sandy soil and clayey loam. Also associated with *Dipterocarpus costatus* in the forests of the Cox's Bazar Division, especially between Whykheong in the Teknaf Range and Ukhia in Rezu Range. Again found sporadically in Joarinalla block of Garjania Range. Reproduces itself naturally around mother trees.

2. *Seed time*.—January-February. Second week of February is the best time for collection. Seed years ~~are~~ irregular.
3. *Weight of seed*.—225 fresh fruits to the lb. 320 fruits to the lb. 6 weeks after collection.
4. *Method of collection of seed*.—Fruits are collected from the trees by lopping branches, also from the ground.
5. *Method of treating seed*.—No treatment is necessary as it is extremely difficult to remove the pulp without damaging the seed.
6. *Method of seed storage*.—Seeds have kept fairly well for 6 weeks in a dry ventilated shed but after this deteriorates very rapidly. Storing of seeds is not recommended.
7. *Sowing (method and quantity of seed)*.—As seeds cannot be stored until the break of the rains direct sowing is impossible. Seeds should be dibbled 4" x 4" in shaded nursery beds as soon after collection as possible. Seeds should be dibbled at a depth equal to the smallest diameter of the seed. 2 lbs. of seeds are required per *kamra*.
8. *Germination (time, percentage, etc.)*.—Germination is slow and difficult. It commences in two months and may not be complete for eight months. Germination in shaded beds has given 40 per cent. and in unshaded beds only 8 per cent.
9. *Treatment in nursery*.—Standard method of weeding and watering.
10. *Method of transplanting*.—Has been transplanted with balls of earth in the first June when plants were small and results were poor. Should be transplanted with balls of earth in June of the second rains when about 9" high. Winter transplanting with balls of earth may be done in the first cold weather when 6" high. Before transplanting the nursery bed should be thoroughly watered. This species is a shade bearer and a shade is essential in its younger stages. Should be put out either in alternate lines with fast growing light demanders, or with *boga-medeloa* as described under paragraph 10, *Lophopetalum fimbriatum*.
11. *Treatment after transplanting (weeding and cleaning)*.—

12. *Tending*.—Treatment of *boga-medeloa* described under paragraph 12 *Dichopsis polyantha*.
13. *Diseases and pests*.—Suffers from attacks of crickets and other insects which nip off the roots and buds in the nursery.
14. *Rate of growth*.—Very slow. 1st year—6"; 2nd year—9". At Mainimukh, Chittagong Hill Tracts Division, a height of 4'—2" was reached at the end of 4th growing season.
15. *General remarks*.—Slow growing. Should not be grown pure. Might be suitable for raising in alternate lines with fast growing light demanders.

***Polyalthia simiarum*** (*Khutti* or *Labshi*—Nep.).

1. *Locality*.—Found sporadically in the lower hills and plains forests of Northern Bengal. Common in Khumani Block of the Jaldhaka Range of the Kalimpong foothills. Seems to prefer slightly moist but well drained sites. Regenerates itself naturally under suitable conditions.
2. *Seed time*.—June-July. Best time of collection is end of June to beginning of July. Good seed years seem fairly regular.
3. *Weight of seed*.—80 fruits to the lb. 170 clean seeds to the lb. 1 lb. of fruits produce 2 ounces of clean seeds.
4. *Method of collection of seed*.—Fruits are collected from the tree by lopping branches or from the ground. The ground under the mother trees should be cleaned beforehand and fruits collected daily so as to avoid insect attacked seeds. Fruits turn dark purple as an indication of ripeness.
5. *Method of treating seed*.—Fruits are heaped in the shade to rot, pulp washed off in water and the seed dried under shade for a few days.
6. *Method of seed storage*.—Seeds are not stored.
7. *Sowing (method and quantity of seed)*.—Seeds are sown as soon after collection as possible, in lines 6' apart, there being 2 rows of seeds to each line, seeds being sown 4" to 6" apart in a row. It is suggested that this species should be grown in alternate lines with faster growing light demanders. In the nursery the seeds are dibbled 3" x 3" in shaded beds as soon after collection as possible.

8. *Germination (time, percentage, etc.)*.—Germination good, 70 per cent. Starts in one month and is completed within 5 months.
9. *Treatment in nursery*.—Standard method of weeding and watering. Pricking out into shaded beds is recommended.
10. *Method of transplanting*.—Transplanted with balls of earth 6' x 6', or 6' apart in alternate lines with fast growing light demanders after 12 months when about 6" high. Winter transplanting with balls of earth in the first cold weather has given 90 per cent. success. Experiments with stump planting have so far been a failure.
11. *Treatment after transplanting (weeding and cleaning)*.—Usual weeding and cleaning. Slow growing and so many cleanings will be required.
12. *Tending*.—
13. *Diseases and pests*.—None noticed yet.
14. *Rate of growth*.—Slow. 1st year—10"; 2nd year—1'—6"; 3rd year—2'—6".
15. *General remarks*.—In the natural forest grows to a good height with a long clean bole and small conical crown. Is slow growing at first and appears to do well under a light shade. Although a cover crop like *boga-medeloa* is not necessary for raising this species, small scale experiments show that it does better in alternate lines with fast growing light demanders than pure in the open.

***Prunus nepaulensis* (Arupate—Nep.).**

1. *Locality*.—6,000' to 10,000'. Is every frost hardy and so is a useful species for putting out over 8,000' where the choice of species is limited. Regenerates itself easily.
2. *Seed time*.—Last half of October–November.
3. *Weight of seed*.—432 fruits to the lb. 640 clean seeds to the lb.
4. *Method of collection of seed*.—Fruits are collected from trees when the outer coat turns black.

5. *Method of treating seed.*—The black pulp is washed off immediately after collection and the seeds are dried in the sun for a few days. At the time of washing water-test should be carried out.
6. *Method of seed storage.*—Seeds may be stored in bags until February in a dry well-ventilated shed. Seeds should be protected against rats.
7. *Sowing (method and quantity of seed).*—Usually sown in March-April direct in lines 6' apart or in *thalis* 6' x 6', 2 seeds in each *thali*. 2½ lbs. of seeds required per acre for sowing in *thalis*. If sown in the nursery seeds should be dibbled 4" x 4" under shade to avoid pricking out. 21 ounces of seed per *kamra* will suffice.
8. *Germination (time, percentage, etc.).*—Germination good. Gives 85 per cent. success. Starts within a fortnight and is complete within 6 weeks. Germinates easily even when frost is on the ground.
9. *Treatment in nursery.*—Pricking out is not necessary. Shades are required to prevent hail damage.
10. *Method of transplanting.*—Transplanted entire in the first June 6' x 6' with or without a handful of earth round the roots. Some Range Officers do ball-planting but this does not appear necessary. Winter-planting when the shoot is leafless and just before the new shoots appear is successful. Natural seedlings have been transplanted into plantations when about 9" in height in July with 50 per cent. success.
11. *Treatment after transplanting (weeding and cleaning).*—Growth is fair, so cleaning is not usually required after the 3rd year.
12. *Tending.*—Seedlings appear to thrive almost as well under cover as in the open, so heavy cleanings are not necessary.
13. *Diseases and pests.*—Badly attacked by insects, rats and squirrels when young, especially in the nursery. Is advisable to spray round the beds with phenyle. Is frost hardly and not damaged by deer.
14. *Rate of growth.*—Growth is moderate. At Rimbick, Darjeeling Division, at an elevation of 7,500' the average rate of growth in plantations is as follows:—1st year—2'—6"; 2nd year—3'—6"; 3rd year—6'; 4th year—8'; 5th year—9'.

Sample Plot No. 8 of Darjeeling Division at Simkona at an elevation of 7,000' gave an average diameter of 10.5", and height of 53' in 37 years. Stem analysis of a tree at Batasi, Darjeeling Division, at an elevation of 7,000', gave a girth of 6'—8", a height of 98', and a volume of 115 c.ft. down to 8" in diameter in 122 years.

15. *General remarks*.—Not a valuable species but useful for filling up blanks at higher elevations where the choice of species is limited.

***Pterocarpūs dalbergioides* (Padank—Burm.).**

1. *Locality*.—An exotic introduced from the Andamans and grown in plantations in the Chittagong Hill Tracts, especially at Kaptai where it has done well. There is a group of excellent trees 56 years old at the back of the Range Office at Kaptai. These produce fertile seeds and are now regenerating themselves naturally. In the Andamans is found in the mixed deciduous or semi-evergreen forests from sea level upto 3,000' elevation. Grows best on well drained lower slopes of hills.
2. *Seed time*.—Seeds ripen from March to May. Seeds may be indented for through the Chief Forest Officer, Andamans. Good seed-years appear to be biennial.
3. *Weight of seed*.—640 to 700 seeds to the lb., 6 weeks after collection. One 2-maund gunny bag of cleaned seed weighs about 26 lbs.
4. *Method of collection of seed*.—Seed is big, 2" across, round, flat and bordered by a wing. Collected from the ground in the first week of April when blown down by wind. Ground under mother trees should be cleared beforehand and fruits collected daily to avoid collection of insect attacked seeds.
5. *Method of treating seed*.—After collection seed should be dried in the sun.
6. *Method of seed storage*.—Seeds may be stored in a dry ventilated shed until ready for sowing in May.
7. *Sowing (method and quantity of seed)*.—Before sowing either direct or in the nursery seeds are treated as follows:—
  - (1). Alternately soaked in water and put out in the sun for 8 to 10 days.
  - (2). Soaked continually in water for 3 days and nights.



The former method is the one recommended for direct sowing and the latter is suitable only when sowing in the nursery. Direct sowing is done 6' apart in alternate *thalis* with such species as *jarul*. An intimate mixture with another species that is slower growing and gives a certain amount of shade is necessary as *padauk* gives an extremely light canopy, and if grown pure heavy and costly cleanings are necessary to keep down the pest *assamlota*. 3 holes are made at each stake and 2 seeds are put in each hole. They are laid flat and covered with soil to a depth equal to the diameter of the seed. About 12 lbs. of seeds per acre are required. In the nursery seeds are dibbled 4" x 4" in unshaded beds. Experiments have shown that better germination has been obtained in unshaded beds.

8. *Germination (time, percentage, etc.)*.—Unless seeds are treated as mentioned in paragraph 7, germination is slow and poor. With treated seeds germination takes from 4 weeks to 3 months and gives up to 35 per cent. success.
9. *Treatment in nursery*.—Usual method of weeding and watering. As the beds are unshaded great care should be taken that adequate watering is done. Pricking out is unnecessary as the plants are put out in the first rains.
10. *Method of transplanting*.—Transplanted 6' x 6" entire with a handful of earth round the roots in alternate *thalis* with other species in June-July of the same year when about 5" high. Seedlings have been transplanted successfully from the natural forest into plantations in July when about 4" high.
11. *Treatment after transplanting (weeding and cleaning)*.—Is light demanding and cannot stand suppression by weeds. If grown pure heavy cleanings will be necessary in order to keep down *assamlota*.
12. *Tending*.—
13. *Diseases and pests*.—Badly browsed by deer.
14. *Rate of growth*.—Fast. The following rate of growth was observed in plantations at Kaptai, Chittagong Hill Tracts Division:—1st year—3'—4"; 2nd year—10' with a breast height girth of 4"; 3rd year—16' and breast height girth of 7". There is a 56-year old plantation at Kaptai with an average height of 60' and an average girth of 3'—9".

15. *General remarks.*—A valuable tree that appears to do well in the Chittagong Hill Tracts and is suited to well drained lower slopes of hills. Is extremely light demanding and gives a very open canopy and for this reason must be intimately mixed with a slower growing species that will give a certain amount of shade and help to keep down *assamlota*.

***Pterocarpus marsupium* (Bijasal—Hind.).**

1. *Locality.*—An exotic with a large distribution. In Madras is found scattered in deciduous forests upto 3,500'. Common mostly between 500' and 1,000' and also on plains level. In Behar and Orissa is common on hilly ground and in valleys, on northerly slopes in both mixed deciduous and *sal* forests. Appears to grow on a variety of formations provided the drainage is good. Prefers a soil with the fair proportion of sand but is often found on red loam with a certain percentage of clay.
2. *Seed time.*—March to April. Seeds are obtained through the Silviculturist, Madras.
3. *Weights of seed.*—46 clean seeds to the ounce.
4. *Method of collection of seed.*—Not done.
5. *Method of treating seed.*—Not done.
6. *Method of seed storage.*—Seeds can be stored until ready for sowing in June.
7. *Sowing (method and quantity of seed).*—Seeds are sown in June direct 6' apart in lines, 2 rows of seeds to a line, seeds being about 6" apart in the row. In the nursery seeds are dibbled 3" x 3" in shaded beds immediately on receipt. 5 ozs. of seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.).*—Germination good, up to 75 per cent. Starts in a week and is complete in 8 weeks.
9. *Treatment in nursery.*—Standard method of weeding and watering. Pricking out is not necessary as this species is put out in its first rains.
10. *Method of transplanting.*—Is transplanted 6' x 6' entire with balls of earth in July of the first year when about 8" high. Winter transplanting with balls of earth in the first cold weather when about 1'—6" high is extremely successful. Pre-monsoon stumping after the first showers in April is reported very successful.

11. *Treatment after transplanting (weeding and cleaning).*—Experiments carried out in Northern Bengal show that a cover crop does not appear necessary with this species. Usual weeding and cleaning is required.
12. *Tending.*—Not known.
13. *Diseases and pests.*—Browsed by game.
14. *Rate of growth.*—Grows fairly fast. At Sukna, Kurseong Division, the rate of growth is as follows:—1st year—1'—6"; 2nd year—2'—6".
15. *General remarks.*—In Madras grows to a large size and is reported to be fast growing. Is a comparatively valuable timber and extremely easy to regenerate under all methods. Should be suitable for growing in both Northern and Southern Bengal.

***Pterygota alata*** (Syn. *Sterculia alata*) (*Gorok narikel*—Chitg.,  
*Labshi*—Nep.)

1. *Locality.*—Found sporadically in the Tista Valley and plains of Northern Bengal. Is fairly common in the evergreen forests of the three Chittagong Divisions. Regenerates itself abundantly especially in the evergreen forests above Mainimukh in the Chittagong Hill Tracts.
2. *Seed time.*—February, March and 1st week of April.
3. *Weight of seed.*—1 lb. of fruits give 2 ounces of clean seeds. 30 seeds to the ounce.
4. *Method of collection of seed.*—Trees are very tall and seed is very difficult to collect. Fruits are collected from trees whenever possible by lopping the small branches containing the pods. Sometimes collected from the ground, but it is preferable to collect from the tree if possible.
5. *Method of treating seed.*—Pods are dried in the sun and seeds extracted by hand. Seeds are then dried in the sun for a few days.
6. *Method of seed storage.*—Can be stored for a couple of months in a dry ventilated shed. Care should be taken to keep them away from damage by rats and ants.
7. *Sowing (method and quantity of seed).*—Usually sown direct either in lines 6' apart, 1 or 2 rows of seeds in each line, or in *thalis* 6' × 6', 3 seeds to a *thali*, in May-June at the break of the rains. In the nursery is dibbled 3" × 3" in shaded beds as soon after collection as possible.

8. *Germination (time, percentage, etc).*—90 per cent. in the nursery where seeds were sown immediately after collection, and from 70 to 80 per cent. when seeds were sown direct and had been stored for 2 months. Germination takes from 3 to 4 weeks.
9. *Treatment in nursery.*—No pricking out is necessary, as plants are put out the same year.
10. *Method of transplanting.*—Transplanted 6'×6', with balls of earth in July of the same year when about 8" high and has given complete success. Winter transplanting in the 1st cold weather with balls of earth has given cent. per cent. success.
11. *Treatment after transplanting (weeding and cleaning).*—
12. *Tending.*—In regular plantations in the Chittagong Division *boga-medeloa* was sown in between the lines and *thalis* in April-May (one month before sowing) in order to keep down weeds and afford shade during the first hot weather. To find out if this species benefits from shade during hot weather, experiments were made and over a small area *boga-medeloa* was removed at the end of the first rains. At the end of the hot weather it was found that there were no casualties in the portion shaded by *boga-medeloa* whereas in the portion where there was no shade over 15 per cent. casualties occurred. From this it appears that this species should be grown with a shade crop on the lines laid down for *gurjan*. Heavy weeding should not be done during the cold and hot weathers, and weeds not actually interfering with the plants should be kept to shade the ground. Climber-pulling should be done whenever necessary. In Northern Bengal a shade crop is not necessary and plants thrive better in the open.
13. *Diseases and pests.*—Defoliators have been noticed on young plants.
14. *Rate of growth.*—Slow at first, 9" in 6 months. 1'—6" in 12 months.
15. *General remarks.*—In the Chittagong district should only be put out on lower slopes of ridges on the cooler north and east aspects, and on better drained ground in depressions.

***Quercus lamellosa* (Buk), *Quercus lineata* (Phalañt), *Quercus pachyphylla* (Sungre katus), *Quercus fenestrata* (Arkawla), *Castanopsis hystrix* (Dalne katus).**

1. *Locality*.—All these except *Quercus fenestrata* occur between 5,000' and 9,000', the latter not appearing above 7,000'. Natural regeneration of *Castanopsis hystrix* is often found on light soil on a warm aspect and where the undergrowth is light. Young regeneration of the oaks is seldom found.
2. *Seed time*.—Good seed-years occur only about every 3 years. Seed is ready for collection in November-December. It is extremely difficult to obtain good seed of any of the above species, especially *dalne katus*, owing to insect-damage. Seeds of *phalañt* are less damaged by insects than any of the other species.
3. *Weight of seed*.—  
*Quercus lamellosa*.—27 fruits to the lb. 50 clean seeds to the lb.  
*Quercus lineata*.—50 fruits to the lb. 80 clean seeds to the lb.  
*Quercus pachyphylla*.—160 seeds to the lb.  
*Quercus fenestrata*.—190 seeds to the lb.  
*Castanopsis hystrix*.—300 clean seeds to the lb.
4. *Method of collection of seed*.—Fruits are collected from the ground but care should be taken that collection is made immediately after seed-fall, otherwise the seeds become quickly insect-attacked. The ground under the mother trees should be cleaned beforehand, and fruits collected daily so as to avoid collection of insect-attacked seeds. As seed-years are not annual, large quantities of seed should be collected when there is good seed-year, and plants may be put out in the plantation, as root-and-shoot-cuttings, as required.
5. *Method of treating seed*.—The fruits are dried for a few days in a dry place and the seeds separated from the cups. As seed is so liable to insect-attack they should be carefully selected and water-tested.
6. *Method of seed storage*.—Seeds are stored in a pit, dug in dry ground, the top layer of seeds should be at least 2' below the surface, which is then filled up with dry earth. Great care should be taken to see that the earth is free from *humus* which may contain injurious insects.

7. *Sowing (method and quantity of seed).*—Seeds should be water-tested before sowing. Seeds are dibbled direct in lines 6' apart, one or two rows of seeds in each line—the rows being 6" apart and seeds 6" apart in the rows. Sometimes are sown in *thalis* 4' × 4', 3 to 5 seeds to a *thali*. Sowing in *thalis* is not recommended, as plants are inclined to fork and branch, and experience shows that much better plants are raised from line sowing. In the nursery, seeds are sown in February, but *phalañt* seeds which germinate earlier may be sown in March.
8. *Germination (time, percentage, etc.).*—  
*Quercus lamellosa*—60 per cent. within 6 months.  
*Quercus lineata*—40 per cent. within 5 months.  
*Quercus pachyphylla*—  
*Quercus fenestrata*—  
*Castanopsis hystrix*—
9. *Treatment in nursery.*—Seeds are dibbled 3" × 3" or 4" × 4" in unshaded beds. No pricking out is necessary. Seedlings are kept from 2 to 5 years in the nursery and plants as root-and-shoot-cuttings are put out annually as required.
10. *Method of transplanting.*—Are difficult to transplant owing to long tap roots. For this reason planting is almost always done by root-and-shoot-cuttings. 2 to 5 year old plants have been used with success. Root pruning is best effected by cutting the tap roots with a sharp spade pushed horizontally from the side of the bed 9" below the surface, 3 weeks before planting. The shoot should be pruned at the collar at the time of lifting. Planting should be done in June at the beginning of the rains, not more than 4' × 4', owing to their tendency to fork and branch. The larger plants of *Castanopsis hystrix* can be transplanted in July of their first rains when 4" in height, the smaller plants remaining in the nursery beds until the second rains.
11. *Treatment after transplanting (weeding and cleaning).*—Weeding and cleaning will have to be done for several years as rate of growth is slow.
12. *Tending.*—Thinning will not be required even in the best-stocked plantations for many years. Thinning should be delayed as long as possible to prevent branching. Thinning of *phalañt* has been the subject of a separate note.

13. *Diseases and pests*.—Seeds are damaged by insects and eaten by rats and squirrels. All species are frost-hardy. White ants have been found to kill off the young seedlings of *Quercus pachyphylla* in plantations. 1912-20 plantations of *phalañt* near Simkona Basti, Darjeeling Division, have been badly attacked by larva of the beetle *Coraeobos dorsalis* Kerem (*Buprestidae*). The larva bores between the cambium and the wood. The affected part swells, the cambium is ringed and the flow of sap is arrested. Badly attacked trees soon die. Dehra Dun suggests that the attack is the outcome of the conditions arising from the density of the stand and would be controlled by adjusting the shade affecting the bole. *Buk* saplings have been killed off by root fungus at Batasi, Darjeeling Division.

14. *Rate of growth*.—Slow.—*Quercus lineata* being the fastest.

*Quercus lineata*.—Sample Plot No. 14, Darjeeling, Division at Rangirum at an elevation of 5,800' gave an average diameter of 10.4", height of 70', and volume of 3,433 cubic feet per acre down to 8" diameter in 33 years.

*Quercus lamellosa*.—Sample Plot No. 13, in the same situation gave an average diameter of 7.1", height of 52', and a volume of 1,114 cubic feet down to 8" in diameter in 28 years.

*Quercus pachyphylla*.—Sample Plot No. 17, Darjeeling Division, at Bhanjang, at an elevation of 6,900' gave an average diameter of 12.1", and height of 63' in 43 years.

15. *General remarks*.—Observations in Manson's Coupes, Darjeeling Division, indicate that *phalañt* and *chañp* (*Michelia excelsa*) grow extremely well when intimately mixed. It is suggested that these species should be raised by quincunx planting with *chañp* in the centre. *Phalañt* is comparatively fast growing and more of this species should be put out by root and shoot cuttings than has been done in the past. *Buk* is too slow and is not recommended for raising in plantations.

**Saccopetalum longiflorum.**

1. *Locality*.—Found sporadically in the lower hill forests, up to 2,000'. To be found chiefly near Khumani and Samsing in the Jaldhaka Range of the Kalimpong foothills and near Tarkhola and Riyang in the Tista Valley. Appears to prefer slightly moist but well drained sites on sandy loam. Regenerates itself naturally under suitable conditions.
2. *Seed time*.—August. Best time of collection is latter part of August.
3. *Weight of seed*.—60 fruits to the lb. 190 clean seeds to the lb.
4. *Method of collection of seed*.—Fruits are collected from the tree by lopping branches or from the ground. The ground under the mother trees should be cleaned beforehand, and fruits collected daily so as to avoid insect attacked seeds. Fruits turn dark purple as an indication of ripeness.
5. *Method of treating seed*.—Fruits are heaped in the shade to rot, pulp washed off in water and the seeds dried under shade for a few days.
6. *Method of seed storage*.—Seeds are not stored.
7. *Sowing (method and quantity of seed)*.—Seeds ripen late and plants from direct sowing are too small at the end of rains to survive. Besides which the seeds germinate with a long coil and the cotyledons persist for some time before the new leaves form, and so when sown in the open the cotyledons are very liable to be dried off by the sun. Experiments with direct sowing even with a shade crop have been a comparative failure and entire transplanting only is recommended. In the nursery the seeds are dibbled 3" x 3" in shaded beds as soon after collection as possible. 10 lbs. of seeds per kamra will suffice.
8. *Germination (time, percentage, etc.)*.—Germination good, 70 per cent. Starts within a month and is complete within 8 months.
9. *Treatment in nursery*.—Standard method of weeding and watering. Pricking out should be done into shaded beds as soon as the plants are big enough to handle.



10. *Method of transplanting*.—This species requires shade in its younger stages and should be planted either in alternate lines with a fast growing light demander or 6' x 6' in conjunction with *boga-medeloa*. If raised with *boga-medeloa* as a shade crop the *boga-medeloa* should be put out in May of the same year. Transplanted with balls of earth in June of the second rains when about 8" high. Winter planting with balls of earth in the first cold weather has given 80 per cent. success.
11. *Treatment after transplanting (weeding and cleaning)*.—If grown with *boga-medeloa* treatment should be on the lines under paragraph 11, *Litsaea panamonja*.
12. *Tending*.—
13. *Diseases and pests*.—None seen yet.
14. *Rate of growth*.—Slow. At Sukna in Kurseong Division the rate of growth in plantations is as follows:—1st year—8"; 2nd year—2'; 3rd year—3'.
15. *General remarks*.—A slow growing species and requires a certain amount of shade at any rate in its younger stages. Should not be grown pure and it is suggested that it should be tried in alternate lines with fast growing light demanders.

***Schima wallichii*** (*Chilaune*—Nep., *Kanok*—Beng.).

1. *Locality*.—Plains up to 5,000'.
2. *Seed time*.—February and early March.
3. *Weight of seed*.—10,000 seeds to the ounce.
4. *Method of collection of seed*.—Fruits are collected from or under the trees.
5. *Method of treating seed*.—Fruits are dried and seeds extracted by gentle thrashing.
6. *Method of seed storage*.—Seeds do not keep and should be sown as soon as possible.
7. *Sowing (method and quantity of seed)*.—Sown in the nursery under shade.
8. *Germination (time, percentage, etc.)*.—Germination is very poor, and commences in 3 weeks.
9. *Treatment in nursery*.—Sow broadcast in shaded nursery beds soon after collection, 1 lb. of seed per *kamra* will suffice. Seedlings should be pricked out when 2" to 3" high.

10. *Method of transplanting*.—Transplanted in June-July of the same year into *thalis* 6' x 6' when 4" to 6" high.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—
13. *Diseases and pests*.—
14. *Rate of growth*.—Growth fairly fast. At Mongpoo 6 year-old plantations gave an average girth of 1'—2'.
15. *General remarks*.—Not much used by the Forest Department but the Cinchona Department reports it to be the next best fuel to *oaks* and *pipli*. It forms an excellent shade under light-demanders up to 5,000' and may therefore be tried for underplanting or mixing with such species as *gamar*, *panisaj*, *saur*, *lampate*. Might also be tried in mixed line sowings in fuel *taungyas* in the Kalimpong foot-hills.

***Shorea robusta* (Sal, Sakhua—Nep.).**

1. *Locality*.—Plains and foot-hills up to 2,000', and up to 3,000' in the Tista Valley, on the best drained soil. Gives good natural regeneration in the lower hill forests of Tista Valley and Buxa Hills. Should only be grown on well-drained land and on areas which have been for many years under canopy, preferably in areas from which *sal* itself has been removed. Sowing in areas, where the canopy has consisted entirely of *mallata* (*Macarunga* spp.) and where the canopy has only been formed for about 15 years is not usually a success, as grass comes up at once and even if the *sal* is with difficulty pulled through it is doubtful if it justifies the cost. After clear-felling and before sowing, the area should be thoroughly examined and Only the highest and best drained areas should be sown with sal. This fact is often lost sight of and cannot be too greatly emphasised. The slopes down to depressions may be planted with *malagiri*, *rakthan*, *lathar*, *lali*, *pakasaj*, etc., and the lower parts with *jarul*.
2. *Seed time*.—Seeds ripen from the end of May to the beginning of June in the plains, and from mid-June to early July in the Tista Valley.
3. *Weight of seed*.—25 to 30 seeds (with wings) to the ounce.

4. *Method of collection of seed.*—Healthy, mature and well-shaped trees should be selected, the jungle underneath cleaned, and seed that has fallen collected each morning. It has been reported that quite often seeds although ripe do not fall readily to the ground. In such cases they are collected by shaking and beating the branches of the trees. Kurseong reports that selected seed from trees grown in the hills gives a better growth in the first year than those from trees in the plains.
5. *Method of treating seed.*—No treatment is necessary. It pays to go over the seeds before sowing and select only the plump and well-filled seeds. Those that are a little yellowish in colour appear to be the best.
6. *Method of seed storage.*—Seeds can be kept for 3 or 4 days, or perhaps longer though it is always advisable to sow as soon after collection as possible.
7. *Sowing (method and quantity of seed).*—Seeds should be sown when the ground is moist and on cloudy days and is best sown just after rain. Seed is dibbled with wings sticking up in hoed up lines 1' wide and 6' apart, 3 rows of seed in each line, the rows being 6" apart and the seeds 3" apart in the rows. The whole area is sown with one row first, and the second and third rows added in succession; this is essential as the germination percentage is not uniformly good throughout the seed-time which lasts about 3 weeks; this method gives all parts of the area a chance of benefiting by the best period. The seed is covered with a light layer of soil. In areas in which the soil is inclined to be dry and sandy, and when it appears that there may be a drought at the time of sowing, the wings of the seed should be removed and the seed dibbled upside down about 2" below the surface of the soil. This always proves successful and prevents the seed being dried up. *Sal* is either sown with *taungya* crops between the lines such as cotton, paddy, brinjals, chillies, or regular departmental crops such as jute or bhutta. When a thick crop such as jute is put out it is advisable to sow it a foot away from the *sal* lines so as to give the *sal* more light, if this is not done the growth of the *sal* is retarded by half during the first rains. The better the cultivation in between the lines the better the results.
8. *Germination (time, percentage, etc.).*—Germination is complete within a week and if selected seeds have been used should give from 75 to 90 per cent. success.

9. *Treatment in nursery.*—*Sal* is never sown in the nursery, because owing to its long tap root, it is practically impossible to transplant.
10. *Method of transplanting.*—Not done.
11. *Treatment after sowing (weeding and cleaning).*—In *taungya* plantations weeding is done free for 2 years, and with departmental crops, such as *jute*, little weeding is required during the first year as the crop keeps down the weeds. Miscellaneous species such as *mallata*, *koel* (*Trema orientalis*), *lampate*, and *goehlo* (*Callicarpa arborea*), which come in naturally should be pulled out when they are small and can be done by hand, and not left until they become too big to uproot easily. It is a practice among the *Garos* in some Ranges to burn in between the *sal* lines in March of the first year. The *jabra* after clearing is collected in 1' wide lines midway between the *sal* lines and burnt about the middle of March. *Sal* leaves fall off and die but new leaves are to be found sprouting within 10 days to a fortnight. Range Officers report that burning gives a good stimulus to the growth of the *sal* and also the growth of weeds and climbers are considerably checked. When *sal* is put out without *taungya*, *boga-medeloa* is sown in the following April, and with *taungya* in April following the second field crop. *Boga-medeloa* is sown between the lines after cultivation of *taungya* or departmental crops in order to keep down weeds and climbers, 20 to 30 lbs. of seeds per acre being used. When *taungya* cannot be done nor departmental crops raised profitably, *boga-medeloa* should never be put out in the first year at the same time as the *sal* as it suppresses the *sal*; it has been found that several plantations so grown were completely ruined. Seeds of *boga-medeloa* are collected in February and March and sown in April thickly like mustard and cress in 1' wide hoed up lines midway between the *sal* lines. *Boga-medeloa* must be sown thickly so as to produce stems like *jute*, if sown thinly it produces big branchy plants which overtop the *sal*. One cleaning is usually required about 6 weeks after sowing. *Boga-medeloa* is pruned back with a sharp knife, 6" from the ground in February-March when one year old, and again 6" above the first cut (i.e., 1' above the ground) in February-March when 2 years old, and this pruning is done annually in March until such time as the *sal* is clear of it. By this method *boga-medeloa* is kept below the level of the *sal*

as far as possible, and if in the rains it is overtopping the *sal* the side branches should be cut off. It has been noted that *boga-medeloa* can only be pruned back once a year, and done twice in April and August it was killed off. Great care must be taken to see that *boga-medeloa* does not suppress the *sal*. It must be used intelligently or it will do more harm than good and each plantation should be treated individually according to its requirements. It appears that climbers get a hold in plantations in their 3rd or 4th year, that is the year after the *taungya* crop has been removed. Climbers-cutting in the past appears to have done little to eradicate them and the oldest plantations from 1917 onwards (18 years old) still have to be cut annually. By cutting the climbers just above the ground it is found that from each cut two or more shoots are produced. These multiply year by year as the climbers are cut over. Climber pulling, instead of climber-cutting, will be done in future. From experiments carried out with different methods of eradicating climbers the following conclusions have been arrived at:—That the roots of dangerous climbers are already in the soil before *taungya* operations begin. Seedling climbers do not develop in time to be a menace to a plantation during the dangerous 4th or 5th years, and can be dealt with by pulling up. It is not practicable to uproot climbers once *sal* has been sown. That when a plantation is hoed as in departmental *taungya* the additional cost of removing roots to a depth of 9", about Rs. 4 an acre, is recovered by savings in climber-pullings in the first 2 or 3 years. Observation in *Modeshia* and *Garo* plantations show that although the *Garo* plantations look best at first, the *Modeshia* areas later on are found to be far freer of dangerous weeds and climbers. This is due entirely to the fact that the *Garos* only use a *dao* and scrape up the surface, whereas the *Modeshias* use a hoe and dig up roots to a greater depth, thus their type of cultivation results in plantations which are much freer of climbers. Results therefore indicate that deep hoeing and removal of climber roots up to a depth of 9" is really the only way to lessen the damage by climbers, the cost on a small scale working out at Rs. 13-8 per acre for hoeing and removal of roots. The Divisional Forest Officers are now carrying out experiments to see if this is financially possible on a larger scale. In older plantations *Mucuna pruriens* and *gurja* (*Tinospora cordifolia*) are the most dangerous and harmful climbers. The former has been responsible

for extensive blanks in plantations and the latter once it has got into the crowns of the trees, lives epiphytically, and can no longer be eradicated and is responsible for most of the malformed *sal*. Before the danger from *gurja* was fully realised it had got a hold in a number of older plantations with the result that there was hardly a straight stem in the plantations. The only way to deal with such areas is to coppice and burn them, and as the new shoots of *gurja* appear above ground during the rains, they are dug up. The results of such operations have been extremely successful but great care must be taken to see that *gurja* is never allowed to get up the trees again. It must be clearly understood by all officers that *Mucuna* and *gurja* must be uprooted at once and that neither time nor money must be spared. Directly these two climbers are noticed coming up in young plantations they must be uprooted immediately, and funds must be obtained to keep them under control or the plantations as far as the production of timber is concerned will be worthless.

12. *Tending*.—The undergrowth in our *sal* plantations is much more evergreen than that under any naturally regenerated *sal* and seems to be becoming even more evergreen. Where conditions are very moist, with much fern, the plantations look unhealthy and sudden deaths are not uncommon. *Sal* plantations 18 years old still have to be freed from herbaceous climbers, as a rule, annually, and if this is not done even pole crops suffer seriously. Fire has been suggested as the obvious remedy for both these troubles. Accordingly, all *sal* plantations of 5 years and over (except those containing much thatch grass or those in which the debris of thinnings were on the ground) were divided into two halves, one of which was burnt experimentally in the hot weather (March). Observations made in November showed that plantations of 5 and 6 years old had received a severe setback, growth had been considerably retarded and epicormic branches produced, many of them being attacked by a defoliator which left the unburnt areas untouched. 7-year old plantations showed the same damage to a less degree, but those of 8 years old as far as could be seen have come to no harm. Therefore orders were issued only to burn plantations of 8 years old and over. It was noticed that plantations burnt late in March have their new flush of leaves delayed considerably. This must retard

growth and burning should be done as early in March as possible. Points to note are that plantations of 8 years old and over can be burnt without causing apparent damage, provided, the canopy is complete, they do not contain much thatch grass, or are not admixed with fire tender species, and no thinning debris are lying on the ground. They should be burnt in March as early as possible so as not to give too fierce a fire, and also so that the new flush of leaves is not delayed. Silvicultural experiments carried out up to date show that as the result of burning, the undergrowth in the burnt plots has been greatly reduced, and whereas at the time of laying out it was usually from knee to waist deep, now it is seldom over 1'-6" high at the most, and in some plots the soil is completely bare except for a few ferns. At the time of laying out the chief species in these plots were ferns (3 varieties) *Piper* sp., *Phlogacanthus thyrsiflorus*, *Boehemeria* sp., *Premna bengalensis*, *Amoora rohituka*, *Litsaea polyantha*, *Sterculia villosa*, *Aralia* sp., *Indigofera* sp., *Machilus* sp., *Urena lobata*, etc. These have now been changed by burning to a drier type of associate such as *Imperata arundinacea*, *Pollinia ciliata*, *Clerodendron infortunatum*, *Coffea bengalensis*, *Ageratum conyzoides*, *Litsaea polyantha*, *Leea crispa*, *Careya arborea*, etc. The undergrowth in the unburnt plots appears to be getting denser chiefly due to increased presence of fern and natural regeneration of such species as *Machilus villosa*, *Ficus* spp., *Amoora wallichii* and *rohituka*, and *Dysoxylum* spp. The number and density of climbers has also been considerably reduced in the burnt plots, partly due to burning and partly to the fact that the burnt areas being cleaner, climber pulling has been easier and more effectively carried out. The cost of climber pulling has been reduced by half in some of the burnt plots. The principal climbers occurring in the burnt plots are *Tinospora cordifolia*, *Millettia auriculata*, *Smilax* sp., and *Spatholobus roxburghii*. It does not appear that the rate of growth of *sal* is affected by burning, but only one set of plots has been remeasured up to date (E. P. Nos. 14A-C of Buxa Division). Plot 14A has been burnt for 5 years in succession, Plot 14B is the unburnt control and Plot 14C has been burnt biennially. Volume figures for each sub-plot were calculated at Dehra Dun and there is no appreciable difference in the rate of growth of *sal* in any of the plots. More will be known on this point when the remainder

of the sets of plots laid out have been remeasured. The canopy of the burnt plots is lighter due to the dying out of suppressed and badly dominated stems from the effects of burning.

Thatch grass (*Imperata arundinacea*) and lemon grass often comes up as a heavy undergrowth in *sal* plantations, and although the area is fully stocked, the rate of growth of *sal* is very slow. In fact, in areas, where the grass is particularly dense the *sal* remains in a *whippy* state and is only revealed by a careful search. Experiments carried out in plantations of 6 years and over show that if the areas are burnt, *sal* coppiced, hoeing of grass roots done between the lines and one rains weeding carried out, it is possible by the end of the first rains to get a good stock of *carroty* seedlings well out of danger from grass.

The thinning of this species has been the subject of a separate note. First thinning should be fairly heavy, leaving from 18 to 22 stems per 100', i.e., 4' to 6' apart depending on the height of the trees. It should not be delayed and must be carried out before the dominants have declared themselves naturally. Second and third thinnings should also be fairly heavy. Suppressed and dominated stems will be removed as experience up to date shows that in most cases dense shade encourages the growth of the worst species of climbers, and that the cutting of suppressed stems greatly assists in climber pulling which becomes both cheaper and more effective. Experience has also shown that thinning is rendered quicker and more efficient by the removal of suppressed and dominated stems by coolies working ahead of the Marking Officer, as subordinates find it very difficult to do a crown thinning only in congested lines of *sal* especially in the first thinning. Again, it is suggested that if the object in burning the *sal* plantations is to change soil conditions, direct sun light will be necessary, and that in fact burning without reducing shade does little more than change the vegetation to a more fire-resistant type without affecting the soil, and for this reason also it is desirable to remove dominated and suppressed stems so as to get light to the ground.

In the past there has been a tendency to fill up very small blanks in the *sal* lines with species such as *kainjal*, *jarul*, etc., which when isolated tend to branch out and suppress the *sal* on either side of the blank. Blanks over 5 yards square should be filled with such



species as *lali*, *tun*, *pakasaj* and smaller gaps with *boga-medeloa*. Grazing has been tried with the idea of keeping down weeds and climbers but the results were bad, and grazing should be definitely closed in young plantations. Buffaloes are harmful and browse the *sal* as much as they do the weeds, and cattle make hard tracks in between the *sal* lines, and prevent proper soil aeration.

13. *Diseases and pests*.—Pigs uproot whole lines of seedlings and plantations must be fenced against pig. Cockchafer grubs eat the roots of young seedlings and kill them. Porcupines damage seedlings. Monkeys often pull up 1-year old plants. The larva of the moth *Euproctis latifascia* (*Hymanthriidæ*) attacks young *sal* seedlings. It starts by defoliating the plant, then attacks the leading shoot and eventually the whole plant, which is often completely destroyed. In the older *sal* plantations (from 10 to 18 years old) saplings have been killed by the fungus *Polyporus shoreae* and isolated attacks of *Hoplocerambyx spinicornis* have been noticed. *Loranthus* has badly attacked a 19-year old plantation at Kodalbusti, Buxa Division. Swellings, sometimes so severe as to expose the wood, are often to be found on the boles of even healthy and vigorous poles and saplings. This is especially noticeable in the 1920 plantation at Sukna, Kurseong Division. The reason for this is not known. Such affected stems should be removed in thinnings in preference to others, when it is possible to do so without creating a gap in the canopy.
14. *Rate of growth*.—Fairly fast after the 3rd year. The following is the average rate of growth in plantations:—1st year—9"; 2nd year—2'—6"; 3rd year—4'—4"; 4th year—9'—5"; 5th year—12'. Sample Plot No. 17, at Kodalbusti in Buxa Division gave an average diameter of 6.3" and height of 58' in 16 years. Sample Plot No. 10 of North Moraghat in Jalpaiguri Division gave an average diameter of 12.9", height of 90', and volume of 2,544 c.ft. per acre down to 8" diameter in 32 years. Measurements of a tree in the natural forest at Sukna, Kurseong Division, gave a girth of 6'—8"; height of 131', and volume of 154 c. ft. down to 8" diameter in 81 years.
15. *General remarks*.—

**Swietenia macrophylla (Mahogany—Eng.)**

1. *Locality*.—This species of *mahogany*, an exotic, appears to be a very promising tree in the Chittagong District where it has been introduced. In the Chittagong Hill Tracts Division it grows best on gentle slopes on cooler aspects, and also on well-drained level ground. Soil loamy to sandy loam and fairly deep. In the Chittagong Division, it is one of the few species that has survived on dry exposed slopes. Is being put out in Northern Bengal on the same soil as suitable for *sal* and appears to be doing very well. It is regenerating itself extremely well from trees of a 35-year old plantation at Kaptai. Another species (probably *Swietenia mahoganii*) has been tried both in Northern Bengal and Kaptai, Chittagong Hill Tracts, with little success.
2. *Seed time*.—Seeds ripen from the beginning of February to early March. Best time is end of February and beginning of March.
3. *Weight of seed*.—900 to 1,000 wingless seeds to the lb. One 2-maund gunny bag of seeds with wings weighs 18 lbs, one 2-maund gunny bag of cleaned seed weighs from 12 to 14 lbs.
4. *Method of collection of seed*.—Local seeds may be obtained from trees at Kaptai and Rangamati in the Chittagong Hill Tracts, and from roadside trees in Noakhali District and in the Duars. Seeds are also obtained through the Silviculturist, Madras, and Botanical Gardens, Sibpur. Mature fruits are collected from the trees when they start to dehisce.
5. *Method of treating seed*.—Fruits are dried in the sun until they open and seeds extracted by hand.
6. *Method of seed storage*.—Seeds may be stored in a dry ventilated shed up to June.
7. *Sowing (method and quantity)*.—Direct sowing is done either in lines 6' apart, or preferably in *thalis* 6' x 6' as seeds are scarce, 4 to 6 seeds per *thali*. 24 lbs. of seeds are required per acre for sowing in lines 6' apart and 8 lbs. for sowing in *thalis* 6' x 6'. Seeds are sown at the beginning of rains. Wings are broken off and seeds are laid on their edges and slightly covered with earth, with just the top of the seed sticking out of the surface of the ground. In the nursery seeds are dibbled 3" x 3" in shaded beds soon after collection. 2 lbs. of seed per *kamra* will suffice.

8. *Germination (time, percentage, etc.).*—Germination takes place in a month and is complete within 3 months. Percentage of success appears to be rather variable. From 20 to 40 per cent. being reported in different years. Poor germination is most likely due to the collection of immature seed, as the writer has noticed at Kaptai that fruits were collected before they had started to dehisce and on opening same the seeds were obviously immature. Germination and general growth of seedlings are reported better in shaded than unshaded beds in the nursery in Northern Bengal, but in Southern Bengal tests have given exactly the opposite result.
9. *Treatment in nursery.*—No special treatment except the standard method of weeding and slight watering. Manuring with leaf mould before sowing will certainly help but does not appear to be an essential condition. No pricking out is necessary, and plants are put out in May-June of the same year when about 6" high. Shades should be removed from the beds 2 or 3 weeks before transplanting.
10. *Method of transplanting.*—Experiments show that the rate of growth and general vigour of the plants at the end of the first year is far better from transplanting than direct sowing. Ball planting in the first rains with 4 months old seedlings gave cent. per cent. success and this is the method recommended for raising *mahogany*. Winter transplanting in Northern Bengal with plants 9 months old was also very successful. Stump planting with seedlings in their second rains is also successful, but results do not appear to be as good as that obtained from transplanting.
11. *Treatment after transplanting (weeding and cleaning).*—In the Hill Tracts there is a great danger of plantations being suffocated by *assamlota* and so frequent weeding must be done. Range officers report that cleanings have to be done frequently for the first four years, and are necessary every fortnight during the first two. Pure *mahogany* 6' x 6' gives a very open crop at first and the canopy does not close up for several years. It is suggested that it should be intimately mixed with a slower growing species that gives a certain amount of ground cover such as *jarul* in order to keep down *assamlota*.

12. *Tending*.—Planting areas should be examined at the beginning of the 2nd rains and vacancies filled up by roof and shoot cuttings from stakes with surplus plants.
  
13. *Diseases and pests*.—The shoot-borer *Hypsipyla robusta* attacks leading shoots of plants during the latter part of the rains but they eventually recover. Squirrels do much damage by eating the bark of the trees. This is done about half-way up the tree, which is sometimes completely girdled and killed. Young plants have been found dead and on examination it was seen that a longicorn larva had entered the stem at the collar and had bored 4" to 6" up the stem. This pest kills off the young plants and has increased a great deal during the past 4 years, and may make raising of this species a doubtful proposition. Young plants from direct sowing have been attacked by red ants a few weeks after germination. The tops were cut off at ground level and plants died.
  
14. *Rate of growth*.—Fast after the second year. The average rate of growth in the plantations of the Chittagong Hill Tracts Division is as follows:—1st year—1'; 2nd year—4'; 3rd year—8'; 4th year 12'; 5th year—18'.  
 Sample Plot No. 9 at Kaptai, Chittagong Hill Tracts Division, at plains level, gave an average diameter of 14.8", height of 87', and a volume of 4,362 c.ft. down to 8" diameter in 43 years.
  
15. *General remarks*.—Specimens of this timber from Kaptai have been sent to Dehra Dun and the reports have been extremely favourable. It should therefore be put out over as large an area as possible. Pure *mahogany* must be avoided until we know to what extent the damage by the collar borer is likely to be. Moreover, experience in Trinidad has shown that undergrowth or better still a shelter belt between the lines is some protection against the shoot-borer *Hypsipyla robusta*, so that a mixture in groups of lines with *gamar*, *panisaj* or other fast growing light demanders seems to be indicated for this species. An intimate mixture in alternate *thalis* with a slower growing species such as *jarul* that gives a fairly good ground cover and so helps to keep down *assamlota* might be another solution. Experiments in alternate line mixtures with *gamar* has not been too successful, although the

*mahogany* looks healthy its growth is very slow. It remains to be seen whether as the canopy rises the *mahogany* will speed up. The ideal method of mixing would appear to be in alternate groups of lines with a fast growing species and that the *mahogany* itself should be mixed in its own lines in alternate *thalis* with some such species as *jarul*. *Boga-medeloa* should not be grown with this species as a cover crop to keep down *assamlota*, as experiments have shown that it definitely retards the rate of growth of *mahogany* and plants look unhealthy.

**Syzygium jambolanum** (Syn. *Eugenia jambolana*) (Jam—Beng.,  
Jamuna—Nep.).

1. *Locality*.—Found throughout the plains forests of Northern Bengal and the three Chittagong Divisions. Prefers moist situations, but is by no means confined to them. Soil sandy loam.
2. *Seed time*.—June.
3. *Weight of seed*.—680 clean seeds to the lb.
4. *Method of collection of seed*.—Fruits are collected from the tree or from the ground. Fruits when ripe fall to the ground. To ensure collection of ripe seeds it is advisable to collect from the ground.
5. *Method of treating seed*.—Fruits are heaped in the shade to rot. The pulp is then washed off by hand and the seeds dried under shade.
6. *Method of seed storage*.—Sow as soon after collection as possible.
7. *Sowing (method and quantity of seed)*.—So far has only been sown direct at Dhobachari in the Chittagong Division. Seeds were sown direct in *thalis* 6' x 6', 3 to 4 seeds per *thali*. It would appear preferable to dibble seeds in lines 6' apart, 2 rows of seeds in each line. In the nursery seeds should be dibbled 4" x 4" in unshaded beds. 8 ounces of seed per *kamra* will suffice.
8. *Germination (time, percentage, etc.)*.—Germination 90 per cent. in a month.
9. *Treatment in nursery*.—Usual standard method of weeding and watering.

10. *Method of transplanting*.—Transplanted experimentally in July of the same year with a handful of earth round the roots and gave good results. It is reported that root-and-shoot-cuttings do well,  $\frac{3}{4}$ " diameter at the collar is the most suitable size.
11. *Treatment after transplanting (weeding and cleaning)*.—
12. *Tending*.—
13. *Diseases and pests*.—
14. *Rate of growth*.—1'—6" at the end of the first rains.
15. *General remarks*.—This species is much used in the United Provinces to plant up heavy water-logged soils.

***Faraktogenos kurzii* (Chaulmugra—Beng.)**

1. *Locality*.—Evergreen forests of the three Chittagong Divisions on well-drained slopes on the cooler aspects, and on undulating and flat ground near streams. Soil loam to sandy loam, elevation 500'. A good shade-bearer.
2. *Seed time*.—Middle of July to middle of September.
3. *Weight of seed*.—100 fresh seeds to the lb. Dry and one year-old seed from 150 to 225 to the lb.
4. *Method of collection of seed*.—Fruits are collected from the ground under seed-bearers. Mature fruits split up by themselves *in situ*.
5. *Method of treating seed*.—If fruits have not dehisced, should be dried in the sun, broken up and seeds extracted. Seeds should be washed in water and then dried in the shade for 3 or 4 days.
6. *Method of seed storage*.—Seeds can be kept for a year in gunny bags in a dry well-ventilated shed but bags must be strung up off the ground as rats are extremely fond of the seeds. Seeds should be taken out at intervals and spread out on mats in the shade to air.
7. *Sowing (method and quantity of seed)*.—Direct sowing has been tried experimentally both with seeds of the same year and with one-year old seed. Direct sowing is not recommended owing to the exceptionally long period which the seed sometimes takes to germinate. As

a case in point in a plantation at Hazarikhil this species was sown in July 6' x 6' in *thalis*, as little or no germination had appeared by next May the area was re-sown with *kanthal*. After the first showers in June of that year it was found that some of the seed had started to germinate with the *kanthal*. If sown direct, sow with fresh seeds thickly in lines 6' apart, 2 rows of seeds to each line. By this method enough seeds will have germinated by the end of the rains to know if the area will be fully stocked or not. If sown in the nursery shades do not appear to be essential but their use is recommended. Seeds are dibbled 3" x 3", the depth of the soil covering being up to the thickness of the smallest diameter of the seed. 10 lbs. of seeds per *kamra* will suffice. Seeds should be laid on their edges and not upward.

8. *Germination (time, percentage, etc.)*.—In the Silvicultural Nursery at Hazarikhil germination commenced in 3 weeks and continued up to 4 to 8 months giving from 40 to 50 per cent. success in both shaded and unshaded beds. Mainimukh, Chittagong Hill Tracts, reports that fresh seeds took a year to complete germination with 85 per cent. success, whereas one-year old seeds only gave 20 per cent. Soaking seeds in water does not appear to speed up germination.
9. *Treatment in nursery*.—Manuring does not appear to be necessary. Pricking out when the seedlings are big enough to handle is recommended otherwise they will be difficult to transplant owing to their long tap roots.
10. *Method of transplanting*.—Transplanted in the following June when from 5" to 6" high entire with balls of earth, or at least a handful of earth round the roots, immediately after removal from nursery beds, preferably on a wet day. Mainimukh reports 60 per cent. survivals from transplants. Stump-planting cannot be done. Shade is essential for raising this species. Should be raised in conjunction with *boga-medeloa* as laid down for *Dichopsis polyantha*. Might do in alternate lines with faster growing light demanders.
11. *Treatment after transplanting (weeding and cleaning)*.—Weeding should not be done during the cold and hot weather, and weeds not actually interfering with the plants should be left to shade the soil during the hot weather.

12. *Tending*.—*Boga-medeloa* should be treated as laid down for paragraph 12, *Dichopsis polyantha*.
13. *Diseases and pests*.—Rats eat the seed. Deer browse the leading shoots in plantations. Very susceptible to drought.
14. *Rate of growth*. Slow. 1st year—6"; 2nd year—1'—8"; 3rd year—3'.
15. *General remarks*.—This species has only been tried on an experimental scale and notes made here are the result of a few observations only. It should not be put out on exposed south and west aspects, but should be confined to lower north and east slopes and flat ground at the bottom of the ridges. From observations in the natural forest at Mainimukh where it regenerates itself naturally under a dense shade, it would appear to be a suitable species for underplanting. As this species seeds late, may be used for sowing up vacancies and blanks in the current year's plantation.

*Tectona grandis* (Teak—Eng., Sagwan—Nep., Segun—Beng.).

1. *Locality*.—An exotic introduced with great success in the Sitapahar and Ringkheong Ranges in the Chittagong Hill Tracts. Soil sandy loam, should be deep and fertile and well-drained and does best on the slopes of ridges. Should not be put out on low ground along the banks of rivers where the ground is clayey and is liable to water-logging, for although it appears to do well for the first few years its roots decay and trees are easily blown over by wind. Fluting also appears to be more prevalent on such soils. Should not be put out on dry exposed ridges of the Chittagong and Cox's Bazar Divisions, as although it germinates well its growth completely ceases after the third or fourth year. Again, in the Chittagong Hill Tracts Division, is not growing well on the rather heavy soil at Mainimukh and should not be put out there any more and should be confined to the Sitapahar and Ringkheong Ranges where it is doing extremely well. Has done well at Bamonpokri, Kurseong Division, in Northern Bengal on the same soil as is suitable for *sal*.
2. *Seed time*.—Seeds ripen in Southern Bengal in January-February, and February-March in Northern Bengal. Seed-years are not always good and it is advisable each year to collect as much seed as possible to act as a reserve supply for the next year.
3. *Weight of seed*.—650 seeds to the lb.



4. *Method of collection of seed.*—Seeds are collected from the ground which must be cleaned beforehand. Seed collection should be made daily in order to avoid collecting insect-attacked seeds.
5. *Method of treating seed.*—After collection seed should be dried in the sun for 6 or 7 days. There are several methods for preparation of seeds before sowing—
  - (1) Seeds are soaked for 48 hours in water and then dried in the sun for 48 hours. This process of alternate soaking and baking is continued for 12 to 15 days.
  - (2) *Pit process.*—This method is the one most commonly used in Bengal. A pit is dug two to three feet deep and three to four feet square and filled with water. When this has run out line the bottom and sides of the pit with *teak* leaves. Soak the seed for 48 hours in water in a tub warmed by the sun during the day, and then put them in the pit with a layer of *teak* leaves between the layers of seeds and a final cover of 6" of earth. Before filling up the pit in this manner 5 bamboo pipes, one in the middle and one at each corner, the latter laid at a slant, are put into position and holes cut in them, so that when the pit has been filled up water can reach all layers. The seeds are kept in the pit for about 10 days and watering is done every alternate day. The pit is then opened and normally about 10 per cent. of seeds are expected to have germinated. Heavy watering must not be done. Successful treatment of seed is a very important item and must be done by a reliable hand.
  - (3) Flat places in each *jhum* are prepared by mid-April and the seed is then spread about 3" or 4" deep and watered every other day when there is not sufficient rain. As seeds start to germinate they are put out at stake into the plantation until the area is fully stocked. This method has not been proved very successful as the radicles are liable to be damaged in transport.
6. *Method of seed storage.*—Seeds can be stored for a year in a dry ventilated shed, but it is of course more satisfactory to use fresh seeds.

7. *Sowing (method and quantity of seed).*—With direct sowing seeds should be sown within at least two days of removal from the pit in *thalis* 6' x 6' 3-5 seeds to a *thali*. 24 lbs. of seeds per acre are required. Seeds should be sown as early as possible not later than the end of April, as experiments have shown that seed sown at the end of April gave over 70 per cent. success, whereas the result of May sowing was only about 50 per cent. Seeds should be sown about  $\frac{1}{2}$ " below the surface of the ground. In the nursery seeds are dibbled in unshaded beds. It is not always the practice to have a central nursery and each *jhumia* should have a small nursery bed in his area with which he can fill up vacancies in the first year with transplants, and in the 2nd year with root and shoot cuttings.
8. *Germination (time, percentage, etc.).*—Germination is usually up to 70 per cent, from treated seeds and takes place within 8 to 12 days after sowing.
9. *Treatment in nursery.*—Watering should be light. No pricking out is necessary.
10. *Method of transplanting.*—Seedlings are transplanted immediately after the break of the rains (June-July) entire with balls of earth or with a handful of earth round the roots when they have 4 leaves besides the cotyledons. Pre-monsoon stump planting after the first showers in April is by far the best method of raising *teak* in plantations and this method has been laid down as the one that will be followed in future. Experiments carried out show that the rate of growth and percentage of survivals from pre-monsoon stump planting in April far exceeds that of either rains stump planting, transplanting, or direct sowing. Enumeration of stumps show that there was cent. per cent. survivals from April planting and that the number decreased gradually until those of June gave only 60 per cent. and July under 30 per cent. The growth of stumps from April planting averaged 7' by the first cold weather whereas stumping and direct sowing in June-July averaged 2'-4" only. This extra height growth in the first year should save a considerable amount of money in cleaning in the second and third years and will more than fully compensate for the extra expenses incurred in the formation of a *kuchha* nursery for raising the stumps. Experiments have shown that *teak* stumps are very hardy and can stand

transport for several days and any amount of rough handling. It is therefore considered more satisfactory to have a central nursery for the whole Felling Series, where work can be supervised under one *mali* than to have them scattered all over the *jhums*. For raising stumps on a large scale a permanent nursery should be maintained in each Felling Series, large enough to raise sufficient number of 2 rains old stumps to plant up the current year's plantation and allow a certain percentage for filling up vacancies in previous years' plantations. About  $\frac{3}{4}$ " diameter at the collar is the most suitable size for stumps. The nursery should be unshaded and not laid out in beds, but should only be a patch of hoed up land and sown up by seeds  $3'' \times 3''$ . This should not cost much in upkeep. Stump planting should be carried out as follows:—A hole equal to the exact depth of the stump is made in the centre of the *thali* with an iron crowbar about 2' long. The stump is then inserted, and the soil firmly pressed in against it by thrusting the crowbar in the ground at an angle close to the stump and levelling the soil tight against the root. Damp soil is necessary for easy and successful stump planting. The essential points are—

- (a) the stump should be planted exactly up to the collar,
- (b) the depth of the hole should exactly be equal to the length of the root,
- (c) when driving the crowbar slantwise and closing the hole, care must be taken that no air spaces are left below or around the root;
- (d) the stump must be very firmly planted; and
- (e) every stump should be tested before it is left, and only if it is resistant to a fairly hard pull should it be considered as satisfactorily planted.

This method is very much quicker than bending down and using a *dao* to make the hole.

11. *Treatment after transplanting (weeding and cleaning).*  
—In areas where *teak* is grown in Southern Bengal much damage is done by *assamlota*, which suffocates the plants when small and later climbs over them bending and breaking the stem. Luckily the weed is very light demanding, so if the plantations can be

fully stocked from the beginning this weed can be more or less kept under. By the end of the fourth year in a fully stocked plantation a complete canopy should be formed and the weed entirely suppressed. So the main object is to get a fully stocked plantation as soon as possible, and when raising plantations by direct sowing to secure this it is advisable to have in the plantation small nurseries in each *jhumia's* area for direct filling. Also during the second rains root and shoot-cuttings may be taken from *thalis* where there is more than one plant planted to fill up vacancies. For stump-planting leave about  $\frac{1}{2}$ "—1" stem and 9" tap root, all side-shoots being cut. With plants in their second year in the nursery, this method of stump-planting has been found to be the most successful way of restocking in the second year. In the first and second years weeding is necessary three or four times during the growing season, and in the third year twice. In the fourth year the canopy should be formed and only climber pulling and cutting back of secondary species should be necessary. With areas raised by pre-monsoon stump planting as laid down in paragraph 10, the rate of growth is much faster and fewer cleanings will be required. Any vacancies in the second year will of course be filled up by root and shoot cuttings.

12. *Tending*.—Thinning of this species has been the subject of a separate note. Thinning should not be delayed and must be a heavy D grade. *Teak* must never be allowed to become suppressed as it has definitely been proved that *teak* that has once been suppressed does not respond to a thinning for 3 or 4 years, and so much increment is lost. Thinning should therefore be so done that the canopy is not completely closed until the year before the next thinning is due. In the case of *teak* all suppressed and dominated stems should be removed in thinning as this species suffers from so many pests and diseases which may become epidemic; these are usually spread from those trees that are sickly and have not got their full room for development. A heavy first thinning is also especially necessary in order to give light to the *bamboos* which are lying suppressed to enable them to shoot up. *Bamboos* besides affording necessary soil covering and preventing soil erosion, so common in *teak* plantations, yield a handsome revenue. In areas where no undergrowth has come up experiments have been carried out to underplant and sow. This

is usually done after the first or second thinning, the species that appear most suitable are *tali*, *chapalish* and *mitenga* bamboo (*Bambusa tulda*).

13. *Diseases and pests*.—Seeds are eaten by rats in the plantations. The *teak-borer* (*Dihammus cervinus*) does a considerable amount of damage, its attack causes a canker formation and trees are often broken off by wind, such trees should be removed in thinning. The *teak* defoliator (*Hybloca pueri*) besides other defoliators often defoliate *teak* over large areas in May and June and strip every leaf. White ants eat the bark. *Teak* pests are numerous but so far in Bengal not much damage has been done. Early and heavy thinning, and the removal of all suppressed, sickly and attacked trees in thinnings is the best preventive. Trees are often fluted and this is only bad in areas not suitable for *teak* such as low-lying clayey land near the banks of rivers.
14. *Rate of growth*.—Rapid. The average rate of growth in plantations of the Chittagong Hill Tracts Division is as follows:—1st year—2'; 2nd year—10'; 3rd year—15'; 4th year—25'; 5th year—30'.  
 Sample Plot No. 13 of Buxa Division at Rajabhat-khawa at plains level gave an average diameter of 8.2" and height of 63' in 14 years.  
 Sample Plot No. 2 at Kaptai, Chittagong Hill Tracts Division gave an average diameter of 11.8", height of 96', and a volume of 1,517 c.ft. down to 8" diameter in 21 years.  
 Sample Plot No. 25 at the same place gave an average diameter of 23.5", height of 122' and a volume 4,267 c.ft. per acre down to 8" diameter in 61 years.
15. *General remarks*.—Pre-monsoon stump planting after the first rains in April is considered the best method and is the one now laid down for raising *teak*. Direct sowing with in-filling of stumps in the second year is considered the next best method. Raising of plantations by transplants besides being expensive and irregular is not recommended for the following reasons: Transplanting takes much longer than direct sowing and with only limited labour available the cleaning of the second year and older plantations are bound to be delayed considerably and a certain amount of damage is done to these plantations by *assamlota*. Also owing to the labour involved in transplanting it is felt that the *ghumias* cultivation is completely subordinated to those of the department, and this is hardly

fair provided success can be obtained without interfering with their legitimate requirements. Pre-monsoon stump planting or direct sowing can be done with complete success and these methods suit the *jhumias*. Stump planting and sowing can be completed by the middle of May before the *jhumia* has to think of sowing his *paddy*, whereas transplanting cannot be done without risk before the end of June at which time he should be putting out his own *paddy*. There is also the danger of drought after transplanting and considerable infillings have to be done in the first and second years. The growth of transplants is far less than that of pre-monsoon stumps, but slightly faster than those raised by direct sowings, but the height growth of the resulting crop was found to be extremely patchy owing to infillings.

***Tephrosia candida* (Boga-medeloa). Cover and shade crop.**

(Also a short note on experiments carried out with certain other species with a view to their suitability as cover crops in *sal* plantations).

1. *Locality*.—An exotic introduced into Bengal, originally by Tea Gardens, and now used in plantations in Northern Bengal as a cover crop to keep down weeds chiefly in *sal* plantations. In both Northern and Southern Bengal is also used when raising species in plantations that require a certain amount of shade during the first few years. Besides acting as a shade crop and affording lateral shade to young plants during the critical first few years, it also helps to keep down weeds and climbers, and is especially useful in Southern Bengal in keeping down the pest *assamlota*.
2. *Seed time*.—December to January in Southern Bengal; and January to middle of March in Northern Bengal.
3. *Weight of seed*.—1,800 seeds to the ounce.
4. *Method of collection of seed*.—Pods are collected from plants when they begin to dehisce by lopping the branches containing the pods, which is usually done at the time of the annual coppicing. To get the maximum quantity of seed, pods may be collected as they ripen. This takes more time, however, and collection will cost rather more.

5. *Method of treating seed.*—Pods are collected and placed on bamboo mats in the sun. The pods dehisce and the seeds are thrown out, this may be assisted by beating with sticks.
6. *Method of seed storage.*—Seeds have been stored in a dry ventilated shed up to 3 years and still retain their power of germination.
7. *Sowing (method and quantity of seed).*—Seeds are sown direct in plantations. 20 to 40 lbs. per acre is the average quantity used. For further details, see under paragraph 11—*sal* (*Shorea robusta*) and under paragraph 4—General notes on *Dipterocarpus* spp.
8. *Germination (time, percentage, etc.).*—Germination cent. per cent. within a fortnight.
9. *Treatment in nursery.*—None done.
10. *Method of transplanting.*—Not done.
11. *Treatment after transplanting (weeding and cleaning).*—Not done.
12. *Tending.*—See under paragraph 4—General notes on *Dipterocarpus* spp. and paragraph 11 under *sal* (*Shorea robusta*).
13. *Diseases and pests.*—Not noticed. Will not grow in swampy areas.
14. *Rate of growth.*—The plant never grows above shrub size. In Cox's Bazar Division unpruned *boga-medeloa* grows up to 12'.
15. *General remarks.*—The great disadvantage of the use of *boga-medeloa* as a cover crop, especially with *sal*, is that it grows too quickly and too tall, and unless very carefully watched and used intelligently will very soon kill out the *sal*. For this reason it cannot be put out in the same year as *sal* in regular plantations, which is a great disadvantage. Owing to its growth it must be coppiced back every year and in addition often has to have its tops and side branches pruned during the rains. All these operations are expensive and cost as nearly as much as would otherwise have had to be incurred in weeding, cleaning, and climber pulling. What is wanted is a species that will require little tending and will not overtop the *sal*.

Experiments are still being carried out in the Silvicultural Experimental Garden at Sukna with other species likely to be suitable as cover crops in *sal* plantations. The following is a short note on species tried up to date:—

- (i) *Cassia tora*.—Was not successful. Although germination is good, it does not appear to give sufficient shade to keep down either *thatch* grass or the more faster growing weeds, and in several cases, was eventually suppressed by weeds before the end of the rains. Another disadvantage is that it is an annual which dies back in October and germination of self-sown seeds does not appear to take place before May. During this period weeds and grass come up in between the lines and the seed does not appear to have the power of germination under the shade given by them.
- (ii) *Leucaena glauca*.—Is sown after mixing with inoculated soil. Results after several years' trial appear more hopeful and it may be quite suitable for a cover crop. The disadvantage is that it cannot be grown without inoculated soil.
- (iii) *Pennisetum purpureum* (*Napier grass*).—Cuttings 1' long are planted in 2 rows 2' apart in between the lines in the first week of June. In each row 2 cuttings were dibbled in the same place and were 1'—6" apart in the row. 95 per cent. of the cuttings gave suckers within 3 weeks and growth was very satisfactory. The drawback with this species is that it has to be cut back 2 or 3 times a year and although it appears to be an excellent cover crop it should only be used in areas where fodder is saleable so as to save the cost of otherwise unremunerative cuttings which must be done, or the *sal* will be suppressed.
- (iv) *Clerodendron infortunatum*.—Although it appeared suitable on a small experimental scale further experiments carried out in divisions show that it gives far too light a shade from 2nd year onwards and for this reason is unsuitable.
- (v) *Tephrosia purpurea*.—A small variety of *Tephrosia candida*. Very common near the sea front in Cox's Bazar Division. Results up to date appear extremely promising. It does not grow anywhere near as tall as *boga-medeloa* but is just as successful in keeping down weeds and climbers. Would not appear to require coppicing back which has to be done annually with *boga-medeloa*. Seeds December-January and seeds can be stored until ready for sowing in May-June.



(vi) *Leea crispa*.—Has only been tried on a very small scale but results up to date are far more promising than with any of the other species tried. It germinates well and easily and dies back completely in the cold weather and by the next rains it shoots up again giving a maximum height growth of about 2'—6". If sown thickly in 1' wide lines, does not interfere with *sal*. It affords an excellent cover between the lines and makes an absolutely clean floor completely eliminating all weeds and climbers. No treatment is required with this species, once sown there is no further expenditure. Seeds October-November and can easily be stored until ready for sowing in May-June.

(vii) *Phaseolus calcaratus* (*Masyemkalai*).—Poor germinator. All plants were eaten up by deer. As deer are extremely fond of this plant it is not advisable to try this as a cover crop.

***Terminalia crenulata* (Syn. *Terminalia tomentosa*) Pakasaj—Nep.).**

1. *Locality*.—Found chiefly in *sal* forests, especially in the Tista Valley, up to 2,500'. Prefers a deep clayey soil in the moister situations. Good natural regeneration is often to be found.
2. *Seed time*.—Middle of April to middle of May. Best time of collection is latter part of April to middle of May.
3. *Weight of seed*.—250 seeds to the lb.
4. *Method of collection of seed*.—Fruit should be collected from the tree and not from the ground. Fruits collected from the ground are often immature and insect attacked. Should therefore be collected from trees by lopping branches. Some Range Officers report that in order to ensure the collection of ripe fruits the best time to collect is just after the tree becomes leafless.
5. *Method of treating seed*.—Fruits are dried in the sun for 3 or 4 days.
6. *Method of seed storage*.—Fruits can be stored in a dry ventilated shed up to May-June. Fruits have been kept for one year but the germination per cent. was poor.

7. *Sowing (method and quantity of seed).*—Seed is usually sown in May-June direct in lines 6' apart, 2 rows of seeds in each line, seeds being 6" apart in each row. 90 lbs. of seeds per acre are required for sowing direct in lines. If sown in the nursery seeds are dibbled 3" × 3" in shaded beds soon after collection. Seeds should be sown with the end of the seed that was attached to the twig downwards, as the root comes out from this end, and should be dibbled to a depth equal to the diameter of the seed.
8. *Germination (time, percentage, etc.).*—Germination takes from 2 to 5 weeks and gives 70 per cent. success.
9. *Treatment in nursery.*—No pricking out is necessary. Shade should be removed 3 weeks before transplanting.
10. *Method of transplanting.*—Transplanting is usually done entire 6' × 6' with a handful of earth round the roots in July of the same year. Some Range Officers transplant with balls of earth but this does not appear to be necessary. Pre-monsoon stumping from 1 year old seedlings after the first showers in April is reported to be an excellent way of regenerating areas that are likely to be water-logged during the rains. About 0.8" diameter at the collar would appear to be the most suitable size for stumps.
11. *Treatment after transplanting (weeding and cleaning).*—Young plants appear to prefer a light cover on the ground so heavy cleaning should not be done. The soil should not be exposed unduly and only climbers and weeds actually interfering with plants should be removed.
12. *Tending.*—In well-stocked plantations raised by dense line sowings thinning will probably be required in the 3rd year certainly in the 4th year. Thinning of this species has been the subject of a separate note.
13. *Diseases and pests.*—Roots are damaged by cockchafer larva. Not attacked by game. Is attacked by a kind of leaf-disease which causes the leaves to die off.
14. *Rate of growth.*—Rapid. The average rate of growth in plantations is as follows:—1st year—3'; 2nd year—9'; 5th year—35'.  
Sample Plot No. 13 at Rajabhatkhawa in Buxa Division at plains level gave an average diameter of 4.8" and height of 42' in 6 years.

Stem analysis of a tree at Nazeoke, Kalimpong Division, at an elevation of 800' gave a girth of 6'-2" a height of 100', and a volume of 84 c.ft. down to 8' in diameter in 72 years.

15. *General remarks.*—Is a very useful species for putting out in *sal* plantations in areas too damp for *sal*, such as depressions leading down to hollows. Is also useful for filling up blanks in *sal* lines. Pre-monsoon stumping in April is an excellent method for filling up areas that are likely to be water-logged during the rains. Should be put out more than has been done in the past.

***Terminalia myriocarpa* (Panisaj—Nep.).**

1. *Locality.*—Plains of Northern Bengal up to 5,000', best between 1,000' and 4,000', especially near *ghoras*. From observations in plantations it would appear that the species does well on nearly every kind of soil. In the Kalimpong foot hills it thrives on dry sandy soil, and does equally well, if not better, in damp lowlying areas associated with *kainjal*. It is therefore a useful species for putting out in damper areas leading down to depressions in *sal* plantations. One of the best and quickest grown plantations ever seen is at Sim, 4,000' in the Darjeeling Division. In the Chittagong Hill Tracts Division of Southern Bengal is confined to the Ringkheong Range. It grows in low lying places near the banks of *ghoras*. Seems to be localised to rocky and stony areas. Excellent natural regeneration is often to be found.
2. *Seed time.*—Northern Bengal middle of January to end of first week of February. Southern Bengal, end of November-December and beginning of January. Best time of collection is December.
3. *Weight of seed.*—Seeds are very minute and difficult to count, approximately 12,000 to 16,000 seeds to the ounce. One 2-maund gunny bag contains about 20 lbs. of seeds.
4. *Method of collection of seed.*—Seeds are collected from the tree by lopping the small branches containing the fruits, and not from the ground. Great care should be taken to collect ripe fruits, which should be collected *not when they are red but when they turn yellow*.

6. *Method of treating seed*.—Seeds are separated from branches and twigs, and dried in the sun for a day or two before storing.
6. *Method of seed storage*.—Seeds can be stored for 2 or 3 months (until the break of the rains) in a dry ventilated shed.
7. *Sowing (method and quantity of seed)*.—Seeds are usually sown direct in lines 6' apart in May-June. Lines are hoed 1' wide and seeds are sown thickly broadcast over a width of 3" in the middle of the line and lightly covered with earth. Better results are obtained by sowing the seed without levelling the soil after hoeing as this helps to prevent seeds being washed away. With direct sowing even on level ground seeds are liable to be washed into little heaps during the rains and so germinate in clumps. As soon as the plants are big enough to handle from 3" to 4" in height they should be pricked out and evenly distributed in the lines. Direct sowing should not be done on ground that is undulating otherwise the seeds are liable to be washed away and seedlings have to be collected from some distance and pricked back into the line again. Experience has shown that when putting out such areas it is cheaper to make *kuchha* unshaded nurseries maintained by the villagers and prick out the seedlings in July of the first rains about 2' apart in the lines. Again, does not appear to germinate when sown direct with *bhadai paddy* as field crop. When *bhadai paddy* is used *panisaj* should be pricked out from *kuchha* unshaded nurseries as mentioned above. If a mixture is required *panisaj* can be pricked about 3' apart and *toon* or *chikrasi* pricked out a foot apart in the same lines, that is to say, 2 plants for each one of *panisaj*. Millet in the Kalimpong foot-hills also retards the rate of growth of *panisaj* and care should be taken to see that it is sown some feet away from the lines of *panisaj* and that it is kept pressed back from the lines during the rains. This species is very light demanding and a pure crop becomes very open after its first thinning about the 5th year. Therefore the common practice now is to sow direct in lines with a mixture of seed of *chikrase* or *toon* preferably *C. microcarpa* (16 parts of *panisaj* to 1 part of *chikrase* or *toon*). 2 to 3 bags of seeds are required per acre for line sowing pure or with a mixture of *chikrase* or *toon*. If sown in the

nursery it is sown in shaded beds soon after collection. 3 to 4 ounces of seed per *kamra* will suffice. Seed should be lightly covered with earth.

8. *Germination (time, percentage, etc.)*.—Germination very poor, usually takes from 3 to 4 weeks and gives from 20 to 30 per cent. success.
9. *Treatment in nursery*.—Regular watering with a fine rose is necessary and the bed should be carefully weeded just after germination. If the seeds germinate in clumps pricking out should be done 3" x 3" in shaded beds in May.
10. *Method of transplanting*.—Transplanting should be done in July of the same rains entire with a handful of earth round the roots. Care should be taken to see roots are not doubled up as this species is rather sensitive to transplanting. Ball-planting is advocated in some Ranges but does not appear necessary except during periods of drought.
11. *Treatment after transplanting (weeding and cleaning)*.—*Panisaj* is an intense light demander and great care must be taken during the first rains to see that the field crops are not allowed to lie over the tops of the *panisaj* lines. This is especially necessary when *bhadaï* paddy or millet is used as a field crop.
12. *Tending*.—Species like *lampate* and *kadam* frequently come in naturally and should be pulled up by hand when small. This is important and the Range Officers should see that such species have been pulled out before the villagers are allowed to leave the area at the end of the 2nd year. Thinning of this species has been the subject of a separate note. Thinning is usually required in the 4th or 5th year and sometimes even in the 3rd. A fairly heavy thinning D grade would appear to be the most suitable, as measurements in Sample Plots show that unless the dominant trees have plenty of room for development they put on very little diameter increment.
13. *Diseases and pests*.—Leaves of young plants are browsed by game, and the bark is often damaged by deer rubbing their horns against the stems. Caterpillars of the moth *Lymantria bivittata* have badly defoliated small areas in the Kalimpong foot-hills. It is reported that this species also defoliates *sal*. The weevil *Auletobius fuliginosus* bores into and destroys the shoots of the young plants.

14. *Rate of growth*.—Fast. At Samsing, Kalimpong Division, at an elevation of about 2,000', the average rate of growth in plantations is as follows:—1st year—3'; 2nd year—10'—1"; 3rd year—17'—8"; 4th year—25'—9"; 5th year—30'—2".  
Sample Plot No. 4 at Samsing in Kalimpong Division gave an average diameter of 6", and height of 54' in 11 years.  
Sample Plot No. 10 at Rajabhatkhawa in Buxa Division at plains level gave an average diameter of 5.7" and height of 57' in 7 years.  
Stem analysis of a tree at Samsing, gave a girth of 6'—2", height of 122', and volume of 173 c.ft. down to 8" diameter in 60 years.

15. *General remarks*.—

***Tetrameles nudiflora* (Mainakat—Nep.).**

1. *Locality*.—In Northern Bengal found scattered in plains and foot-hills forests, especially the latter, up to 3,000'. Also in the forests of the Chittagong District where it is to be found both in evergreen and deciduous forests. Comes up naturally in cleared and burnt areas.
2. *Seed time*.—Seeds ripen in May-June. Best time of collection is early part of June.
3. *Weight of seed*.—
4. *Method of collection of seed*.—Fruits are collected from trees by lopping branches. Fruits turn a dark green colour as an indication of ripeness.
5. *Method of treating seed*.—Fruits are dried in the sun for 4 or 5 days in order to get the capsules to burst and seeds are extracted by hand.
6. *Method of seed storage*.—Not done. Seeds are sown immediately after collection.
7. *Sowing (method and quantity of seed)*.—Seeds are sown broadcast in line 6' apart immediately after collection. Is a fast grower and a poor germinator. It is suggested that the best way to raise this species is in mixed line sowings with a slower growing species that stands a certain amount of shade such as *chikrase*, *toon*, (*C. microcarpa*), etc. If sown in the nursery is sown broadcast in shaded beds as soon after collection as possible. 8 ounces of seeds per *kamra* will suffice.

8. *Germination (time, percentage, etc.).*—Germination is poor and slow..
9. *Treatment in nursery.*—Usual method of weeding and watering. Pricking out is advisable as plants will have to remain until the second rains.
10. *Method of transplanting.*—Transplanting entire with a handful of earth round the roots in June of the second rains.
11. *Treatment after transplanting (weeding and cleaning).*—
12. *Tending.*—
13. *Diseases and pests.*—None noticed up to date.
14. *Rate of growth.*—Fast. Trees in the natural forest are reported to put on an average rate of girth increment of 1.7" per annum.
15. *General remarks.*—Is a good box-planking timber. Should not be grown pure but would appear to be a suitable species for growing either in mixed line sowings with a slower growing species that will stand a certain amount of shade, or in alternate lines with a slower growing shade bearer. In the experimental fuel *taungyas* of the Kalimpong Division mixed line sowings with *mallata* (*Macaranga denticulata*) look very promising.

***Trewia nudiflora* (Pitali—Beng.).**

1. *Locality.*—In Northern Bengal and the Chittagong District along the banks of large streams on silt. Comes up naturally in blanks such as old grazing grounds where the ground is well drained.
2. *Seed time.*—End of July to beginning of August. Occasionally fruits may be found up to November, but the best time for collection is 3rd week of July to the 1st week of August.
3. *Weight of seed.*—20 fruits to the lb. 95 clean seeds to the ounce. 18 lbs. of fruits give 1 lb. of clean seed.
4. *Method of collection of seed.*—Fruits can be collected from the tree, but are more usually collected from the ground as they fall in large quantities when ripe. Ground should be cleaned under mother trees and fruits collected daily to prevent collection of seeds that might be insect-attacked.

5. *Method of treating seed.*—Fruits should be placed in a pit and allowed to rot for about 2 weeks. The rotten fruit is then broken up under foot and the pulp is removed by hand. Seeds are then washed in water and dried under shade for several days.
6. *Method of seed storage.*—Seeds treated as above and carefully dried can be stored successfully until ready for sowing the following May-June. It is reported that seeds store better when mixed with ashes in a gunny bag. Experience has shown that seeds stored until the following June give excellent results. Seeds are therefore stored until the following June and sowing is not done immediately after collection as was the custom in the past. Seeds are not ripe until August and if sown then seedlings are very small at the end of the rains, whereas by sowing in June seedlings have the benefit of two extra months' growth and money is saved in weeding and cleaning.
7. *Sowing (method and quantity of seed).*—Seeds stored from the previous year are sown in June direct in *thalis* 4' × 4', or in lines 6' apart, 1 or 2 rows of seeds in a line, the seeds being about a foot apart in the row. Seeds germinate well and should not be sown too close otherwise seedlings look unhealthy. This is the only method recommended as owing to its long tap root unless great care is taken it is difficult to transplant, also the rate of growth and general vigour of direct sown seedlings is much better than transplants. 16 lbs. of seeds are required per acre for direct sowing. In the nursery seeds are dibbled 3" × 3" in unshaded beds in February-March in order to get seedlings about 4" high by the breaks of the rains. 3 lbs. of seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.).*—Germination starts in 3 weeks and is complete within 2 months giving from 90 to 100 per cent. success.
9. *Treatment in nursery.*—Usual standard method of weeding and watering. No manuring is required. Seedlings may be pricked out when about 4" high.
10. *Method of transplanting.*—Transplanted 4' × 4' with balls of earth in June from seed sown either in February-March or in the previous August. Seedlings collected from the natural forest in July when about 8" high have been transplanted into the plantation in July with success. Cent. per cent. success has been obtained from stump planting with seedlings in their second rains. Rate of growth and general vigour of plants



raised either as transplants or stumps is not as good as that of the plants raised from direct sowings.

11. *Treatment after transplanting (weeding and cleaning).—*Plants must be kept well-weeded as they appear to suffer very badly from suppression by weeds. Growth is especially poor in grassy areas.
12. *Tending.*—In direct line sowing thinning is usually required in the 3rd or 4th year.
13. *Diseases and pests.*—Seedlings were noticed to have been attacked by insects in the nursery, and ashes were sprinkled round the plants. Is attacked by a leaf defoliator.
14. *Rate of growth.*—Fast. 1st year, seedlings from direct sowing in May 3'—6"; sown in August 1'; 2nd year—9'; 3rd year—22'—8".  
Stem analysis of a tree at Sankosh, Buxa Division, at plains level, gave a girth of 6'—10", a height of 88', and a volume of 98 c.ft. down to 8" in diameter in 44 years.
15. *General remarks.*—Is a good matchwood. Is deciduous for a good part of the year and therefore if grown pure gives a very light canopy and weeding and cleaning may be costly. Sown in alternate *thali* 6' × 6' with *kainjal* as a subsidiary species looks an extremely promising mixture, and if the *kainjal* appears to be growing too fast all that is necessary is to pollard it.

***Tsuga brunoniana* (Tengree salla—Nep.).**

1. *Locality.*—9,000' to 10,000' chiefly confined to the Ramam spur in the Singalila Range where rainfall and humidity is comparatively low.
2. *Seed time.*—November-December.
3. *Weight of seed.*—9 lbs. of cones yield 1 lb. of clean seed. 11,000 seeds to the ounce.
4. *Method of collection of seed.*—Ripe cones as they start opening are collected by lopping branches.
5. *Method of treating seed.*—The cones are spread out on mats in the sun for 2 or 3 days to dry after which seeds are extracted by gentle thrashing. Seeds should then be dried for a few days in the sun.

6. *Method of seed storage*.—Seeds may be stored for some time in a well-ventilated shed, but should be put out in the sun periodically to air.
7. *Sowing (method and quantity of seed)*.—The seeds are sown broadcast in shaded nursery beds in February. 4 lbs. of seeds per *kamra* will suffice.
8. *Germination (time, percentage, etc.)*.—Germination is complete within 45 days and gives from 80 to 90 per cent. success.
9. *Treatment in nursery*.—Observations show that growth in pricking out beds is extremely irregular. This is probably due to two facts, lack of *mycorrhiza* in the soil, and that the seedlings are pricked out far too small. Seedlings of conifers should be allowed to remain in the seed beds longer and be pricked out larger than is the rule with broadleaves, as they cannot stand the shock so well. Pricking out beds should therefore be mixed with soil collected from the roots of mother trees and pricking out 4" × 4" should not be done until the seedlings are at least 3" to 4" high. Daily watering and weeding when necessary should be done.
10. *Method of transplanting*.—Transplanted 4' × 4' in June-July of the 2nd rains. At higher elevation are often kept in the nursery until the 3rd rains.
11. *Treatment after transplanting (weeding and cleaning)*.—Frequent weeding and cleanings will be necessary for the first 3 years at least as the species is fairly slow growing.
12. *Tending*.—
13. *Diseases and pests*.—At Batasi trees have been attacked and killed by a root fungus.
14. *Rate of growth*.—Slow, but speeds up about the 3rd year after planting. At Rimbick, Darjeeling Division, at an elevation of 7,500' the average rate of growth in plantations is as follows:—1st year—1'—3"; 2nd year 2'—6"; 3rd year—3'—7"; 4th year—9'; 5th year—10'.  
Sample Plot No. 19 at Ramam, Darjeeling Division, at an elevation of 8,500' gave an average diameter of 13.4", height of 87', and volume of 9,187 c.ft. of timber per acre down to 8" diameter, in 66 years. Stem analysis of a tree at an elevation of 8,500' gave a diameter of 16", height of 63' and a volume of 40 c.ft. down to 8" diameter in 50 years.

15. *General remarks.*—This species is found naturally confined only to the Ramam spur, Darjeeling Division, where the rainfall and humidity is less than half that of the surrounding hills at Rimbiak and Batasi. Already a virulent root-fungus is attacking and killing trees in the older plantations at Batasi, Darjeeling Division, probably due to too moist conditions. It is recommended therefore that this species should only be put out in plantations where rainfall and humidity is the same as at Ramam. Should be grown close, not less than 4' x 4', as branches persist and it is very difficult to get clean boles.

***Vitex glabrata* (Ashwal—Beng.).**

1. *Locality.*—Common in the deciduous and scattered in the evergreen forests of the three Chittagong Divisions; on comparatively dry aspects and exposed slopes on well-drained ground. Soil sandy loam, elevation up to about 750'.
2. *Seed time.*—2nd week of July to beginning of August.
3. *Weight of seed.*—2,000 seeds to the lb.
4. *Method of collection of seed.*—Fruits are collected from the ground under and around mother trees. Before collection the ground should be cleaned and fresh seeds collected every day as they fall, so as to avoid collecting insect-attacked seeds.
5. *Method of treating seed.*—Fruits are heaped under shade for a few days to rot and the pulp removed by hand. Seeds are then dried in the sun for 2 or 3 days.
6. *Method of seed storage.*—Not done. Should be sown as soon after collection as possible.
7. *Sowing (method and quantity of seed).*—Direct sowing is not recommended because the germination per cent. is usually very low, and so in order to get good stocking by direct sowing a large quantity of seeds will have to be sown. When sown in the nursery shades should not be used. Seeds should be dibbled 3" x 3" and laid on their edges, and be covered with soil up to the depth of the smallest diameter of the seed. 10 ounces of seeds are required per *kamra* for spacing 3" x 3".

8. *Germination (time, percentage, etc.).*—Begins in 8 to 10 days and is complete in one month in unshaded beds, and takes slightly longer in shaded beds. Germination per cent. is very low, so far 35 per cent. in unshaded and only 9 per cent. in shaded beds has been recorded.
9. *Treatment in nursery.*—No special treatment except the standard method of weeding and watering. Manuring will help but does not appear to be an essential condition. Pricking out is done when the plants are big enough to handle, and they are kept in the nursery till the following rains.
10. *Method of transplanting.*—Transplanting should be done in *thalis* 6' × 6' entire with a handful of earth round the roots in the following June-July. Stump-planting has been tried experimentally with cent. per cent. survivals, but growth does not appear to be as good as that from transplants.
11. *Treatment after transplanting (weeding and cleaning).*—This species appears to be a fairly intense light demander, so the sowing of *boga-medeloa* between the lines is not recommended. All weeds overtopping the young plants should be removed but intense weeding which unduly exposes the soil should not be done or the plants may dry up during the hot weather.
12. *Tending.*—
13. *Diseases and pests.*—Leaves are often attacked by defoliators during the cold weather which, however, appear to do little harm.
14. *Rate of growth.*—Rapid. 1st year—2'—6"; 2nd year—8'; 3rd year—12'.
15. *General remarks.*—This species is one of the few recommended for putting out on the more exposed south and west aspects of ridges as it appears to stand a certain amount of drought. Should not be grown with a cover crop as its growth is considerably retarded when not exposed to the full overhead light. Has only been tried experimentally and many of the notes are based on few observations only. Would appear to be suitable for growing in alternate lines with slower growing shade bearers. Shade definitely retards the growth of this species.

***Vitex peduncularis* (Harina—Beng.).**

1. *Locality*.—Common in the deciduous and scattered in the mixed evergreen forests of the three Chittagong Divisions; on comparatively dry aspects and exposed slopes, and occasionally along the banks of streams on well-drained ground; soil sandy loam; elevation up to 750'.
2. *Seed time*.—Fruits mature early in July, and the best time for collection is between middle of July to 1st week of August.
3. *Weight of seed*.—1,210 fruits to the lb. 1,952 clean seeds to the lb.
4. *Method of collection of seed*.—Fruits are collected from the tree or from the ground. Before collection the ground under the mother trees should be cleaned, and fresh seeds collected daily as they fall so as to prevent collecting insect-attacked seeds.
5. *Method of treating seed*.—The fruits are heaped under shade for a few days to rot and the pulp removed by hand. Seeds are then dried in the sun for 2 or 3 days.
6. *Method of seed storage*.—Not done. Should be sown immediately after collection.
7. *Sowing (method and quantity of seed)*.—Direct sowing is not recommended because germination per cent. is usually very low, and so in order to get good stocking by direct sowing a large quantity of seed will have to be sown. In the nursery shades should *not* be used. Seeds should be dibbled 3" × 3" and laid down on their edges, and covered with soil up to the depth of the smallest diameter of the seed. 10 ounces of seeds are required per *kamra* for spacing 3" × 3".
8. *Germination (time, percentage, etc.)*.—In shaded beds germination takes about a month and in unshaded beds about 3 weeks. Percentage of germination is very low, and so far only 10 per cent. has been obtained in shaded and 17 per cent. in unshaded beds. Experiments have been carried out at Hazarikhil with alternate drying and soaking of the seeds, and by treating with Hydrochloric Acid before sowing, but with no success, and the only results obtained have been from untreated seed sown immediately after collection.

9. *Treatment in nursery*.—No special treatment except the standard method of weeding and watering. Manuring helps but does not appear to be essential. Pricking out is done when the plants are big enough to handle and they are kept in the nursery until the following rains.
10. *Method of transplanting*.—Transplanting should be done in *thalis* 6' x 6' entire with balls of earth or with a handful of earth round the roots in the following June-July; both methods have been reported successful. Stump planting has been done experimentally with poor results.
11. *Treatment after transplanting (weeding and cleaning)*.—This species appears to be a fairly intense light demander so the sowing of *boga-medeloa* between the lines is not recommended. All weeds overtopping the young plants should be removed, but intense weeding which unduly exposes the soil should not be done, or the plants may dry up during the hot weather.
12. *Tending*.—
13. *Diseases and pests*.—Leaves are often attacked by defoliators during the cold weather which, however, appear to do little harm.
14. *Rate of growth*.—Not so fast as *ashwal*. 1st year—10"; 2nd year—6'; 3rd year—9'.
15. *General remarks*.—This species is one of the few recommended for putting out on the more exposed south and west aspects as it appears to stand a certain amount of drought. Should not be grown with a cover crop as its growth is considerably retarded when not exposed to the full overhead light. Has only been tried experimentally and many of the notes are based on few observations only. Would appear to be suitable for growing in alternate lines with slower growing shade bearers. Is slower growing and under all methods is more difficult to raise than *Vitex glabrata*. Shade definitely retards the growth of this species.



## APPENDIX.

Table of seed times.

| Scientific Name.   | Month of the year.  |      |        |        |      |       |       |      |       |      |      |      |
|--|---|------|--------|--------|------|-------|-------|------|-------|------|------|------|
|  | Jan.  | Feb. | March. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
| <i>Abies densa</i> ..  |   |      |        |        |      |       |       |      |       | N    | N    |      |
| <i>Aescia catechuroides</i> ..   | N   | N    |        |        |      |       |       |      |       |      |      |      |
| <i>Aescia lenticularis</i> ..  |   |      | N      | N      | N    |       |       |      |       |      |      |      |
| <i>Aesc. campbellii</i> ..   |   |      |        |        |      |       |       |      |       |      | N    | N    |
| <i>Aerocarpus fraxinifolius</i> ..   |   |      |        | N      | N    | N     |       |      |       |      |      |      |
| <i>Adina coriifolia</i> ..   | B   | B    | B      | B      | B    |       |       |      |       |      |      | B    |
| <i>Ailanthus grandis</i> ..  | N   | N    | N      | N      | N    | N     |       |      |       |      |      |      |
| <i>Albizia lebbek</i> ..   | B   | B    | B      | B      | B    |       |       |      |       |      |      |      |
| <i>Albizia marginata</i> ..  | N   | N    | N      | N      | N    |       |       |      |       |      |      | N    |
| <i>Albizia prostrata</i> ..  | B   | B    | B      | B      |      |       |       |      |       |      |      | N    |
| <i>Alnus cephalensis</i> ..  | N   | N    |        |        |      |       |       |      |       |      |      | N    |
| <i>Alstonia scholaris</i> ..   |   |      |        | B      | B    |       |       |      |       |      |      |      |
| <i>Amora wallichii</i> ..  |   |      |        |        | B    | B     | A     |      |       |      |      |      |
| <i>Antipersea globosa</i> ..   |   |      |        | S      | S    | S     |       |      |       |      |      |      |
| <i>Artocarpus indicus</i> ..   |   |      |        |        |      |       | B     | B    | B     |      |      |      |
| <i>Artocarpus chaplasha</i> ..   |   |      |        |        |      |       | B     | B    | B     |      |      |      |
| <i>Artocarpus integrifolia</i> ..  |   |      |        |        | N    | N     | N     |      |       |      |      |      |
| <i>Betula alnoides</i> ..  |   |      |        |        |      |       |       |      |       |      |      |      |
| <i>Betula alnoides</i> Var. <i>acuminata</i><br>and Var. <i>cylindrostachya</i> .. | N   | N    | N      | N      |      |       |       |      |       |      |      | B    |
| <i>Bischofia javanica</i> ..   | B   | B    |        |        |      |       |       |      |       |      |      | B    |
| <i>Bombax malabaricum</i> ..   |   |      | B      | B      | B    |       |       |      |       |      |      |      |
| <i>Buclandia populnea</i> ..   | All the year round, usually most seed available in January. |      |        |        |      |       |       |      |       |      |      |      |
| <i>Calophyllum polyanthum</i> ..   |   |      |        |        | S    | S     |       |      |       |      | N    | N    |
| <i>Castanopsis hysterix</i> ..   |   |      |        |        |      |       |       |      |       |      | N    | N    |
| <i>Cedrela febrifuga</i> ..  | N   | N    | N      | N      |      |       |       |      |       |      |      |      |
| <i>Cedrela microcarpa</i> ..   |   |      | N      | N      | N    | N     |       |      |       |      |      |      |
| <i>Cedrela toona</i> ..  |   |      | S      | S      | S    | N     | N     | N    |       |      |      |      |
| <i>Chukrasia tabularis</i> ..  | B   | B    | B      | B      |      |       |       |      |       |      |      |      |
| <i>Cinnamomum cecidophloeum</i> ..   |   |      |        |        |      |       |       |      | N     | N    | N    |      |
| <i>Cinnamomum glaucoflavum</i> ..  |   |      |        |        |      |       |       |      | N     | N    | N    |      |
| <i>Cryptomeria japonica</i> ..   |   |      |        |        |      |       |       |      | N     | N    | N    | N    |
| <i>Cupressus funebris</i> ..   |   |      |        |        |      | N     | N     | N    |       |      |      |      |
| <i>Cupressus torulosa</i> ..   | Ripens from June in the United Provinces                    |      |        |        |      |       |       |      |       |      |      |      |
| <i>Dalbergia latifolia</i> ..  | N   | N    | N      | N      | N    | N     |       |      |       |      |      | N    |
| <i>Dalbergia sissoo</i> ..   | N   | N    | N      |        |      |       |       |      |       |      |      |      |
| <i>Dioscorea polyantha</i> ..  |   |      |        | S      | S    | S     |       |      |       |      |      |      |
| <i>Dipterocarpus turbinatus</i> ..   |   |      |        |        | S    | S     | S     |      |       |      |      |      |
| <i>Dipterocarpus sietus</i> ..   |   |      |        | S      | S    | S     |       |      |       |      |      |      |
| <i>Dipterocarpus costatus</i> ..   |   |      |        |        | S    | S     |       |      |       |      |      |      |
| <i>Dipterocarpus pilosus</i> ..  |   |      |        |        | S    | S     | S     |      |       |      |      |      |
| <i>Dipterocarpus tuberculatus</i> ..   | Ripens in May in Burma.                                     |      |        |        |      |       |       |      |       |      |      |      |
| <i>Druabango sonneratioides</i> ..   |   |      |        | B      | B    | B     | B     |      |       |      | N    | N    |
| <i>Eriobotrya petiolata</i> ..   |   |      |        |        | S    | S     | S     |      |       |      | N    | N    |
| <i>Eucalyptus citriodora</i> ..  |   |      |        | S      | S    | S     | S     |      |       |      |      |      |
| <i>Eucalyptus globulus</i> ..  |   |      |        | N      | N    |       |       |      |       |      |      |      |
| <i>Eugenia cymosa</i> ..   |   |      |        |        | S    | S     |       |      |       |      |      |      |
| <i>Eugenia gracilis</i> ..   |   |      |        |        | S    | S     | S     |      |       |      |      |      |

Note.—N—Northern Bengal. S—Southern Bengal. B—Both Northern and Southern Bengal. T—Tista Valley. P—Plains.



APPENDIX I—*concl.*Table of seed times—*concl.*

| Scientific Name.                               | Month of the year.                          |      |        |        |      |       |       |      |       |      |      |      |   |  |
|--|---|------|--------|--------|------|-------|-------|------|-------|------|------|------|---|--|
|  | Jan.  | Feb. | March. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |   |  |
| <i>Erodia melaleuolia</i>                      | N   | N    | N      |        | N    | B     | B     | S    |       |      | N    | N    | N |  |
| <i>Gmelina arborea</i> ..                      |   |      |        |        | S    | S     |       |      |       |      |      |      |   |  |
| <i>Hopsea odorata</i> ..                       |   |      |        |        |      |       |       |      |       |      |      | N    | N |  |
| <i>Hovenia dulcis</i> ..                       | N   | N    | N      |        |      |       |       |      |       |      |      |      |   |  |
| <i>Hymenodictyon excisum</i>                   | N   | N    | N      |        |      |       |       |      | N     | N    | N    |      |   |  |
| <i>Juglans regia</i> ..                        |   |      |        |        |      |       |       |      |       |      |      | S    | S |  |
| <i>Lagerstroemia flor-robinae</i>              | B   | B    | N      | N      |      |       |       |      |       |      |      |      |   |  |
| Seeds during the cold weather in the Andamans. |   |      |        |        |      |       |       |      |       |      |      |      |   |  |
| <i>Lagerstroemia hypoleuca</i>                 |   |      |        |        |      |       | S     | N    | B     | N    |      |      |   |  |
| <i>Litsea panamensis</i>                       |   |      |        |        |      |       | N     | N    | N     |      |      |      |   |  |
| <i>Lophopetalum flabratum</i>                  |   |      |        |        |      | N     | N     | N    |       | N    | N    | N    |   |  |
| <i>Mosiera densicarpa</i>                      |   |      |        |        |      |       |       | N    | N     | N    | N    | N    | N |  |
| <i>Mosiera pustulata</i>                       |   |      |        |        |      |       |       |      |       |      | N    | N    | N |  |
| <i>Macchia edulis</i> ..                       | N   |      |        |        |      |       |       |      |       |      | N    | N    |   |  |
| <i>Macchia gameana</i>                         |   |      |        |        |      |       |       |      |       |      | N    | N    |   |  |
| <i>Magnolia campbellii</i>                     |   |      |        |        |      |       |       | N    | N     |      |      |      |   |  |
| <i>Melastoma thomsoni</i>                      |   |      |        |        |      |       | B     | B    | B     | B    |      |      |   |  |
| <i>Morus ferrea</i>                            |   |      |        |        |      |       |       | B    | B     | B    |      |      |   |  |
| <i>Mitrella champeae</i>                       |   |      |        |        |      |       |       |      |       |      | N    | N    | N |  |
| <i>Mitrella excelsa</i> ..                     |   |      |        |        |      |       |       |      |       |      | N    | N    | N |  |
| <i>Mitrella laurifolia</i>                     |   |      |        |        |      |       |       |      |       |      |      |      |   |  |
| <i>Morus indica</i> ..                         |   |      | N      | N      | N    | N     |       |      |       |      |      |      |   |  |
| <i>Morus laevigata</i> ..                      |   |      |        |        | N    | N     | N     |      |       |      |      |      |   |  |
| <i>Phoebe attenuata</i>                        |   |      |        |        |      |       | N     | N    |       |      |      |      |   |  |
| <i>Phoebe hanceana</i>                         | In Assam seeds September-October.           |      |        |        |      |       |       |      |       |      |      |      |   |  |
| <i>Pinus longifolia</i>                        |   |      |        | N      | N    | N     | N     |      |       |      |      |      |   |  |
| <i>Podocarpus nerifolia</i>                    | B   | B    | B      | B      |      |       |       |      |       |      |      |      |   |  |
| <i>Polyscias simularum</i>                     |   |      |        |        |      | N     | N     | N    |       |      |      |      |   |  |
| <i>Prunus nepalensis</i>                       |   |      |        |        |      |       |       |      |       | N    | N    | N    |   |  |
| <i>Pterocarpus dalbergioides</i>               | Seeds ripen from March-May in the Andamans. |      |        |        |      |       |       |      |       |      |      |      |   |  |
| <i>Pterocarpus marsiprum</i>                   | Seeds March-April in Madras.                |      |        |        |      |       |       |      |       |      |      |      |   |  |
| <i>Pterygota alata</i> ..                      |   | B    | B      | B      | B    |       |       |      |       |      | N    | N    | N |  |
| <i>Quercus</i> spp.                            |   |      |        |        |      |       |       |      |       |      |      |      |   |  |
| <i>Succopetalum longiflorum</i>                |   |      |        |        |      |       |       | N    | N     |      |      |      |   |  |
| <i>Scima wallichii</i> ..                      |   | N    | N      | N      |      |       |       |      |       |      |      |      |   |  |
| <i>Shorea robusta</i> ..                       |   |      |        |        |      | P     | P     | T    | T     |      |      |      |   |  |
| <i>Swietenia macrophylla</i>                   |   | B    | B      | B      |      |       |       |      |       |      |      |      |   |  |
| <i>Syzygium jambolatum</i>                     |   |      |        |        |      | B     | B     |      |       |      |      |      |   |  |
| <i>Taraktognos kurzii</i>                      |   |      |        |        |      |       |       | S    | S     | S    |      |      |   |  |
| <i>Tectona grandis</i> ..                      | S   | S    | B      | N      | N    |       |       |      |       |      |      |      | S |  |
| <i>Tephrosia candida</i>                       | B   | B    | N      | N      |      |       |       |      |       |      |      |      |   |  |
| <i>Terminalia crinita</i>                      |   |      |        |        | N    | N     |       |      |       |      |      | S    | S |  |
| <i>Terminalia myriocarpa</i>                   | S   | N    | N      |        |      |       |       |      |       |      |      |      |   |  |
| <i>Tetracela nudiflora</i>                     |   |      |        |        |      | B     | B     | B    |       |      |      |      |   |  |
| <i>Trewia nudiflora</i> ..                     |   |      |        |        |      |       |       |      |       |      |      |      |   |  |
| <i>Tunga bromeliacea</i>                       |   |      |        |        |      |       |       | B    | B     |      | N    | N    | N |  |
| <i>Vitex glabrata</i> ..                       |   |      |        |        |      |       |       | S    | S     |      |      |      |   |  |
| <i>Vitex pedunculata</i>                       |   |      |        |        |      |       |       | S    | S     |      |      |      |   |  |

Note.—N—Northern Bengal. S—Southern Bengal. B—Both Northern and Southern Bengal. T—Tista Valley. P—Plains.





## APPENDIX III.

**Headings under which Nursery and Plantation Notes for Bengal are to be collected.**

1. *Locality*:—
  - (a) Nature of forest and soil.
  - (b) Elevation.
  - (c) If species regenerates itself naturally, where and under what conditions.
2. *Seed time*:—
  - (a) Period during which mature seed is found.
  - (b) Best period to collect seed.
  - (c) If good seed years irregular, give details.
3. *Weight of seed*:—
  - (a) Number of uncleaned fruits to the lb.
  - (b) Number of cleaned seeds to the lb. or oz.
  - (c) Weight in pounds of uncleaned fruit required to produce 1 lb. or oz. of cleaned seed.
4. *Method of collection of seed*:—
  - (a) Whether from the tree or ground.
  - (b) Any special care to be taken in collection.
  - (c) Colour, if any, indicating ripeness.
5. *Method of treating seed*:—
  - (a) Method of extraction of seed.
  - (b) Method of cleaning seed.
  - (c) Method of drying (under shade or in sun).
  - (d) Any other special treatment necessary.
6. *Method of seed storage*:—
  - (a) Period of storage particularly with regards to use in second season.
  - (b) Method of storage (sheds, pits, etc.)
  - (c) Whether immediate sowing essential or not.
  - (d) Any protection against insects, rats, etc.
7. *Sowing (method and quantity of seed)*:—
  - (a) Method recommended. Whether direct in lines or in *thalis* or in nurseries.
  - (b) Spacing in plantation when sown direct.
  - (c) Quantity in lbs. of cleaned seed required per acre for direct sowing.
  - (d) In nursery, method of sowing, whether broadcast, dibbled or in drills.
  - (e) In nursery quantity of cleaned seed required per *kamra* for methods under (d).
  - (f) Use of shades, etc.
  - (g) Month when sown (i) direct; (ii) in the nursery.
  - (h) Any special treatment before sowing, (e.g., Pit process, etc.).

8. *Germination (time, percentage, etc.):—*

- (a) In terms of percentage.
- (b) Period lapsing between sowing and first germination, (i.e., appearance of cotyledons).
- (c) Period lapsing between sowing and last germination.

9. *Treatment in nursery:—*

- (a) Notes on whether manuring, and watering necessary.
- (b) Any special treatment to hasten germination.
- (c) Any special treatment to avoid insects.
- (d) If pricked out, give spacing; height of plants above ground; any special treatment necessary, e.g., whether under shade or without; whether shades should be removed before transplanting, etc.
- (e) How long plants are to be kept in the nursery.

10. *Method of transplanting:—*

- (a) Ball planting necessary or not. If not, whether entire with or without a handful of earth round the roots.
- (b) Month of transplanting.
- (c) Size of plants when transplanted. Measurement to be taken above ground only.
- (d) Interval of time between removal from nursery to plantation.
- (e) Whether stump-planting done or not. Give age of plants and size at collar. Whether pre-monsoon stumping possible.
- (f) Winter planting done or not. If so, any special treatment required (e.g., such as, stripping of leaves).
- (g) Are natural seedlings ever transplanted from the forest; give size above ground.

11. *Treatment after transplanting (weeding and cleaning):—*

- (a) Use of cover crops.
- (b) Weeding, cleaning, number and month in which done.
- (c) Whether heavy cleaning should be done or not.
- (d) Which weeds are particularly harmful.

12. *Tending:—*

- (a) Age at which first and subsequent thinnings should be done, intensity, etc.
- (b) Climber-pulling, etc. Method and number.

13. *Diseases:—*

14. *Rate of growth:—*

- (a) Whether cold weather growth occurs or not.
- (b) Annual height growth, for first five years.

15. *General remarks:—*

Remarks on general or silvicultural interest and importance, etc.





